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NAVAER 01-60JKE-502

6 86

## Handbook Maintenance Instructions

*NAVY MODEL*

FJ-4B

AIRCRAFT

## SECTION IX ELECTRONIC SYSTEMS

PUBLISHED BY DIRECTION OF  
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## Introduction to SECTION IX

THIS HANDBOOK IS ONE OF A SERIES OF TEN which contain information required by using activities for the maintenance of Model FJ-4B aircraft. These are systems type handbooks. Each system is covered completely in a particular handbook. This includes all hydraulic, pneumatic, mechanical and electrical portions of the system. This has been done in order to assist the mechanic in becoming familiar with and in maintaining all phases of each system.

The "Electronic Systems" handbook contains only nonclassified maintenance data for electronics equipment peculiar to the FJ-4B aircraft. Further information on classified electronics equipment is contained in the FJ-4B Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A).

This handbook contains information necessary for the performance of class C and class D maintenance on those items of Contractor Furnished Equipment for which there are no separate handbooks. This handbook does not contain instructions for the overhaul of components. Such instructions are contained in separate handbooks of overhaul instructions for the individual components.

Instructions for the repair of aircraft structure are contained in the Handbook of Structural Repair (NAVAER 01-60JKD-503) for these aircraft.

Data necessary for obtaining replacement parts and for complete identification of parts are contained in the Illustrated Parts Breakdown (NAVAER 01-60JKD-504) for these aircraft.

Weight and Balance Data are found in the applicable AN 01-1B-40 handbook for each of these aircraft.

To identify and obtain these publications and handbooks covering separate items of equipment, refer to the Naval Aeronautic Publications Numerical Index (NAVAER 00-500).

BuAer Serial Numbers 139531 through 139555, 141444 through 141489 and 143493 through 143643 have been assigned to the FJ-4B. In addition, a lower case letter has been made a part of each serial number as it is painted on the aircraft. These lower case letters have been assigned to blocks of serial numbers as follows:

SERIAL NUMBER	LETTER
139531 through 139555	i
141444 through 141489	j
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# FJ-4B *Fury*



FJ-4B Airplane

## GENERAL INFORMATION

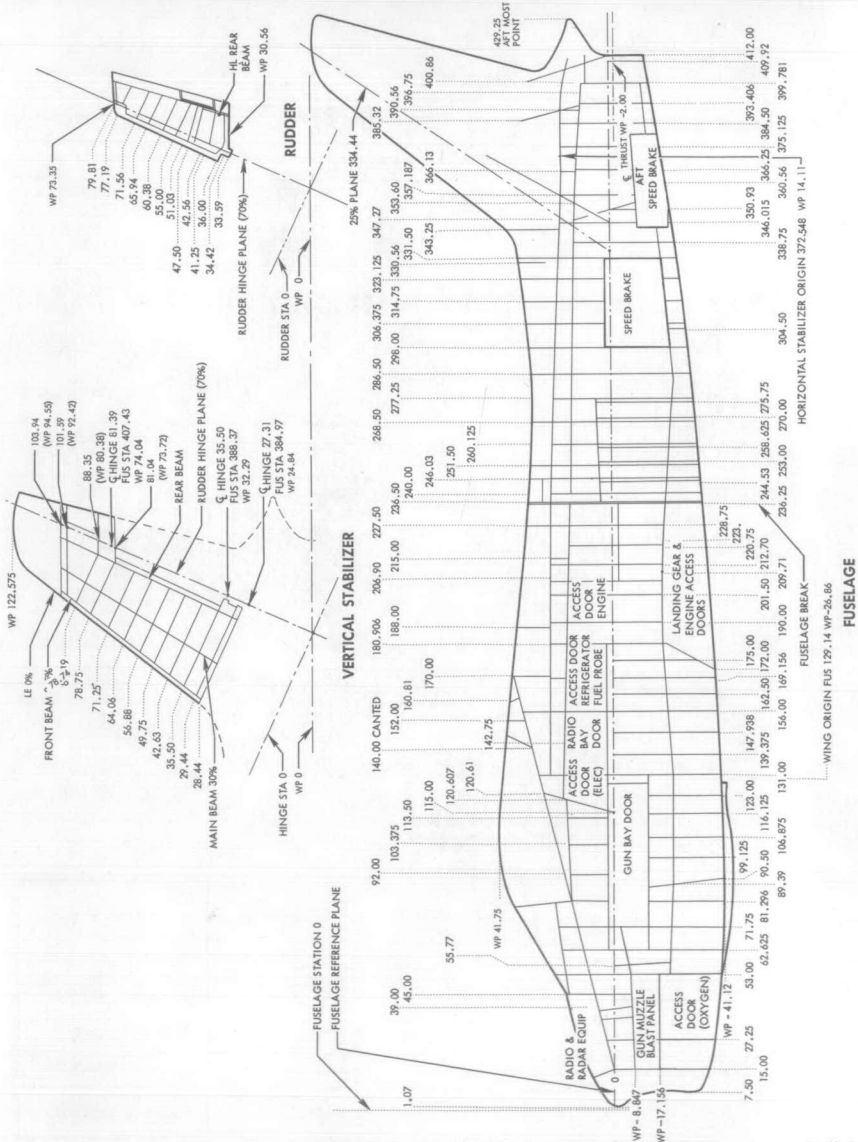


Figure No. 9-1. Airplane Stations (Sheet 1)

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Figure No. 9-1. Airplane Stations (Sheet 2)

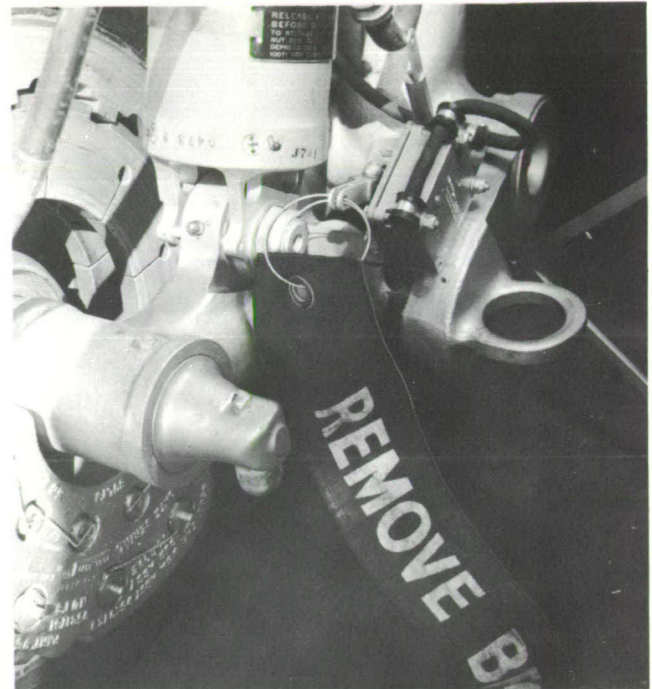


**Warning** Ground safety locks and pins are to be installed at all times, except for flight and gear retraction check. Remove immediately before flight and stow in cockpit map case.

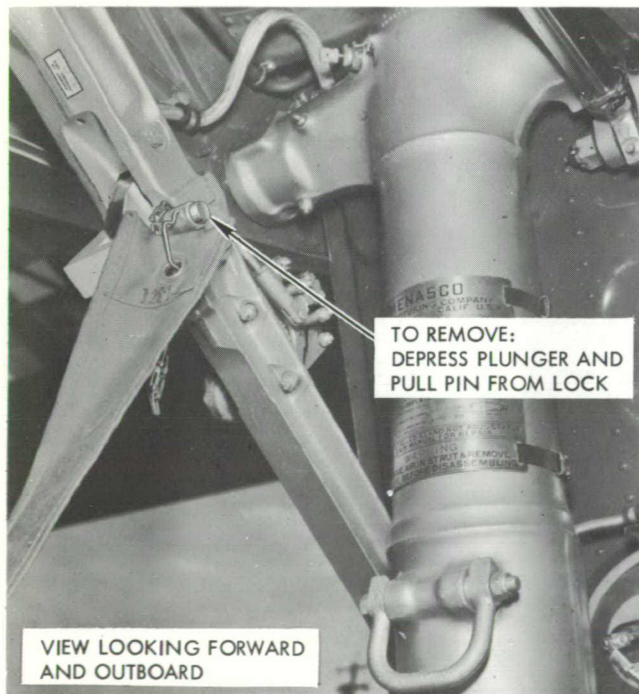
A time-saving method for performing certain testing procedures on the airplane (which normally would require the use of ground jacks) may be accomplished by disabling the ground safety switch. Attach a red warning flag, similar to the flags used on the landing gear ground safety locks, whenever the ground safety switch is disabled.

**Warning** When a red warning flag has been attached to the ground safety switch to indicate a disabled switch, never remove flag from the unit until switch has been properly connected.

## GROUND SAFETY SWITCH



## NOSE LANDING GEAR GROUND SAFETY LOCK



**Note** There is no ground safety lock for the arresting gear.

## MAIN LANDING GEAR GROUND SAFETY LOCK

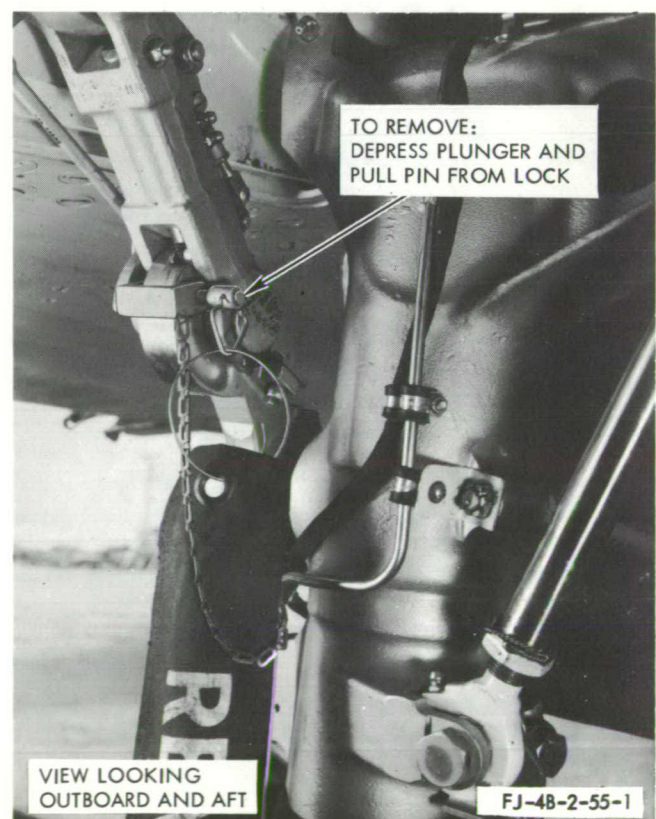
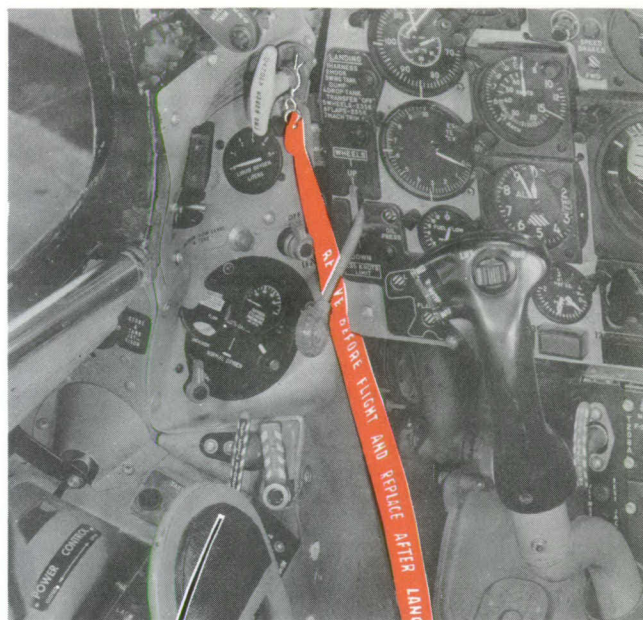


Figure No. 9-2. External Ground Safety Locks and Pins

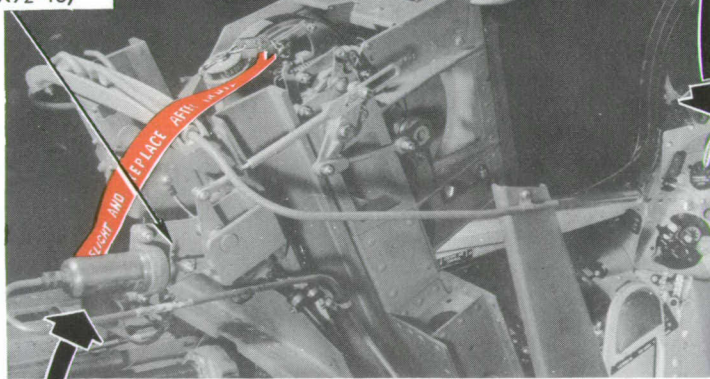


## Warning

- Keep out of the cockpit unless maintenance is required.
- Always consider the emergency escape system loaded and armed.
- Know where the safety pins are and be certain of their installation.
- Do not manipulate linkage without full knowledge of the emergency escape system.
- Do not use linkage or handles as handgrips.
- The catapult cartridge, canopy remover, remover initiators and exactor are ordnance items and should be checked and maintained only by qualified personnel.



PRIMARY CANOPY  
INITIATOR SAFETY  
PIN  
(P/N ALX92-15)



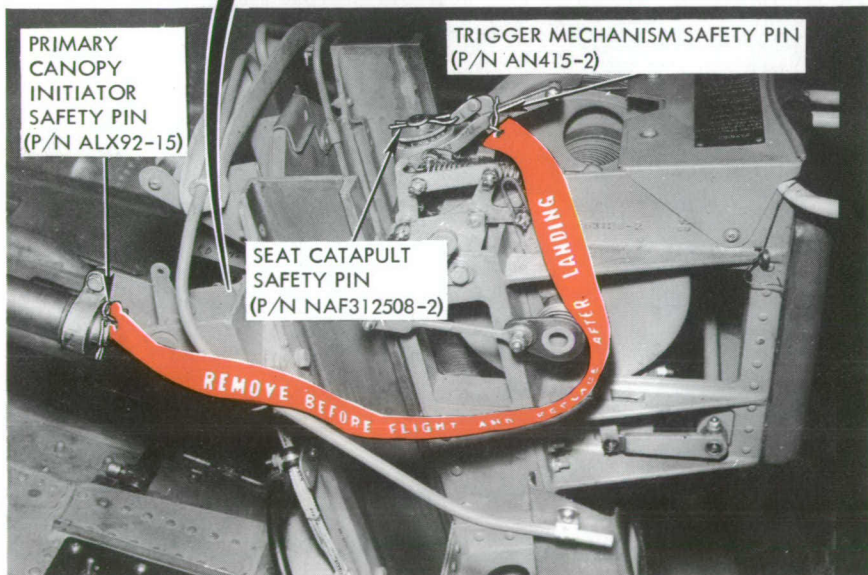
CANOPY  
EMERGENCY  
RELEASE  
HANDLE  
SAFETY PIN  
(P/N ALX92-15)



PRIMARY  
CANOPY  
INITIATOR  
SAFETY PIN  
(P/N ALX92-15)

TRIGGER MECHANISM SAFETY PIN  
(P/N AN415-2)

SEAT CATAPULT  
SAFETY PIN  
(P/N NAF312508-2)



TRIGGER MECHANISM  
SAFETY ON

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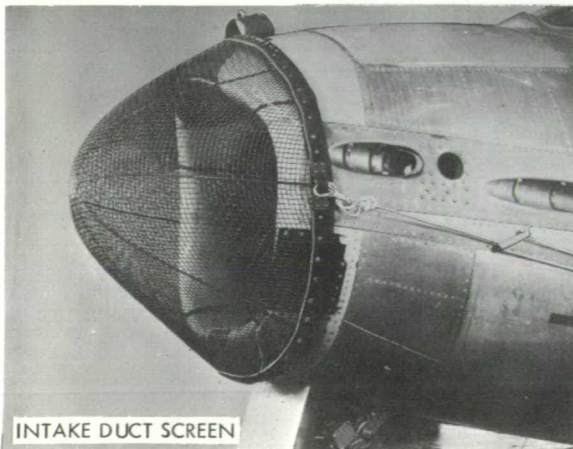
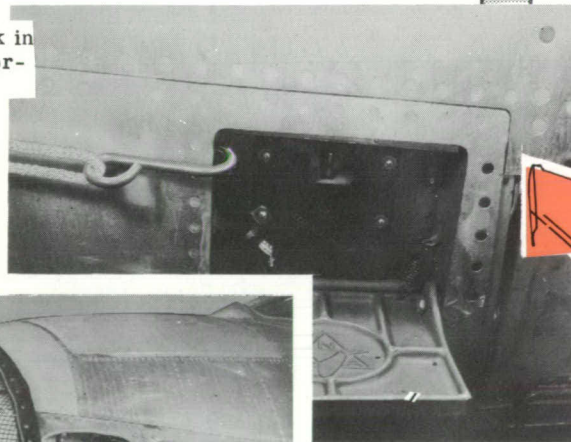
Figure No. 9-3. Emergency Escape System Ground Safety Pins



*Warning*

- Do not stand near the front of the air inlet duct while the engine is operating.
- Always approach the airplane from the side but not in the plane of rotation of the turbine when the engine is running.
- Avoid wearing hats or other loose clothing when working in the run-up area.
- Do not carry loose articles such as pencils, key rings or tools when near the air inlet duct.
- Do not foolishly experiment with the margin of safety by standing near, or feeling with your hand, the suction created by the engine.
- Do not stand on wing of the airplane while engine is operating, unless assistance is required during cockpit check-out or functional check of equipment.
- The loudest sustained noise produced by man is the noise of a jet engine operating at high rpm. Jet-engine noise is dangerous to personnel working in the immediate area. At distances from 50 to 200 feet, wear ear plugs and at distances within a radius of 50 feet, wear ear plugs and a type of over-the-ear protector. Prolonged exposure to jet-engine noise can cause pain and damage to the inner ear. Other effects of prolonged exposure are fatigue, nervousness and impairment of hearing.
- Do not stand at the edge of the blast area as the temperature could suddenly increase with engine speeds.

Place retaining rope hook in existing hole located in forward frame of step.



INTAKE DUCT SCREEN

ATTACH POINT AT STEP

**Caution** The area in front of the air inlet duct should be swept clean to minimize the possibility of dirt or other objects being drawn into the compressor and damaging the engine.

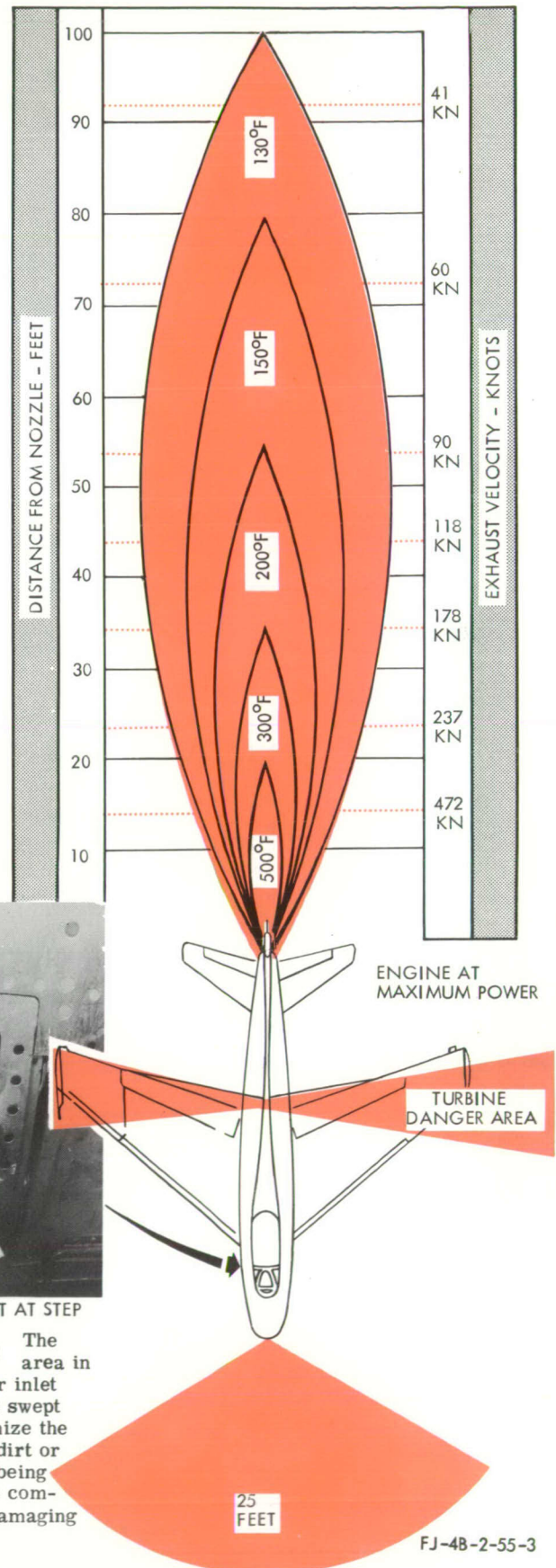
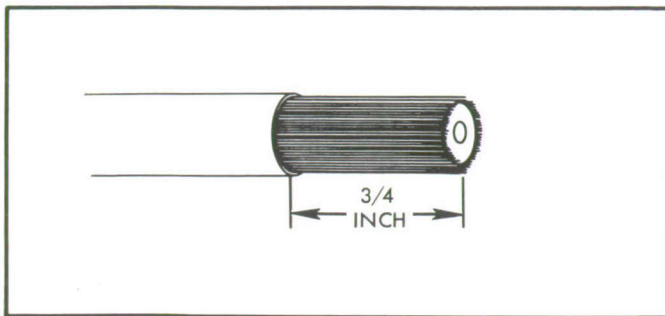


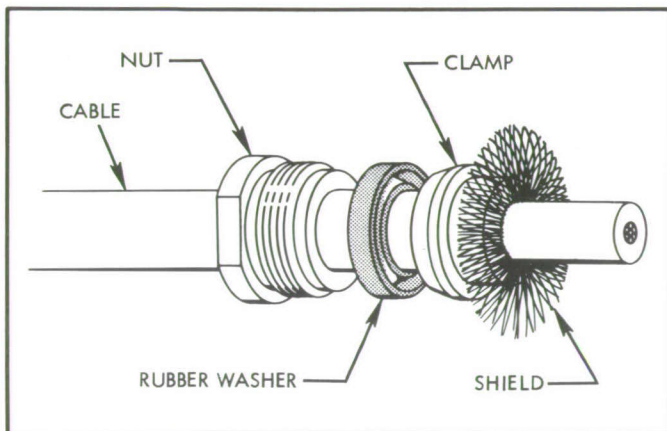
Figure No. 9-4. Ground Run-up Danger Areas

- 1** Cut off 3/4 inch of the outer jacket to expose shielding.



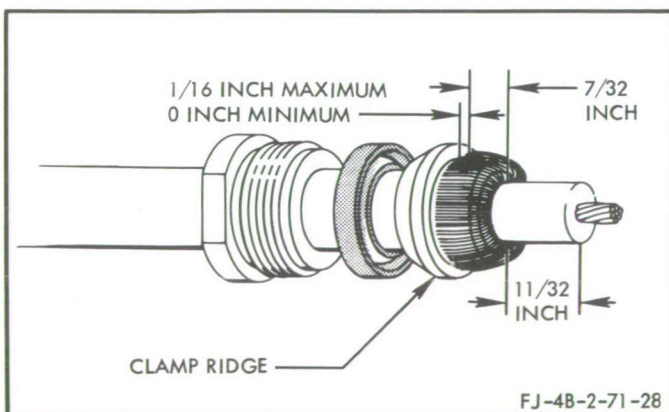
**Caution** Use care to prevent cutting shielding.

- 2** Comb shielding out and taper over dielectric (plastic insulation around center conductor).



- 3** Slide nut and rubber washer (flat side next to nut) over outer jacket. Slide clamp over shielding until jacket enters recess and butts lip in clamp.

- 4** Fold shielding out radially and distribute evenly around cable.

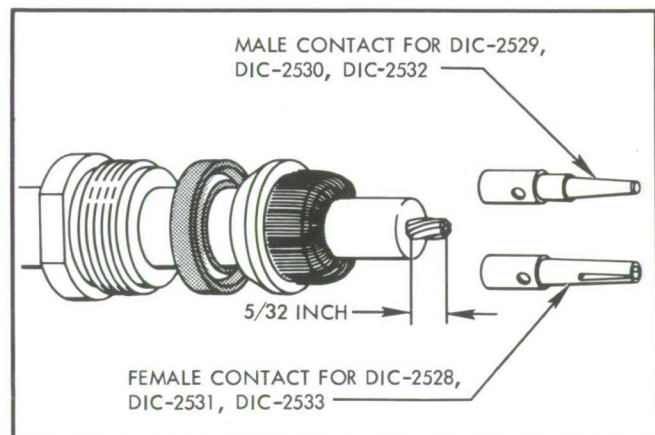


- 5** Use cutters to trim shield to 7/32 inch.

- 6** Fold shield over clamp. Shield must not lap over clamp ridge but must be within 1/16 inch of the clamp ridge.

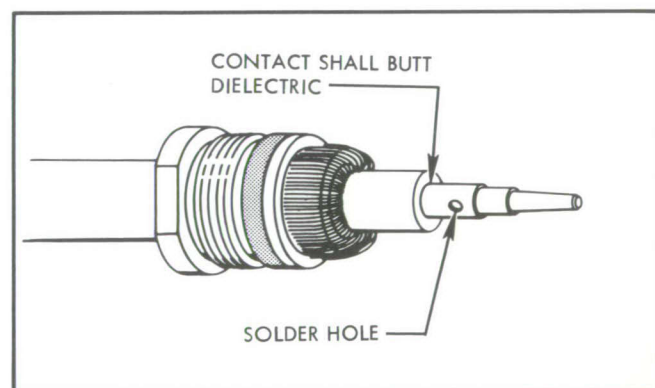
- 7** Measure 11/32 inch from the folded shield; cut around dielectric. Remove cut section from center conductor.

**Caution** Use care to prevent nicking center conductor.



- 8** Trim center conductor to 5/32 inch from dielectric.

- 9** With a small fine file, slightly round the tip and sides of the center conductor to fit the contact if necessary. Slide pin on until it butts dielectric.



- 10** Solder contact to the center conductor. Fill solder hole completely. Should excess solder and rosin remain on contact, remove with a soldering iron, or if necessary, a small fine file. Use care to prevent scoring contact plating.

- 11** Push nut and rubber gasket until they butt clamp.

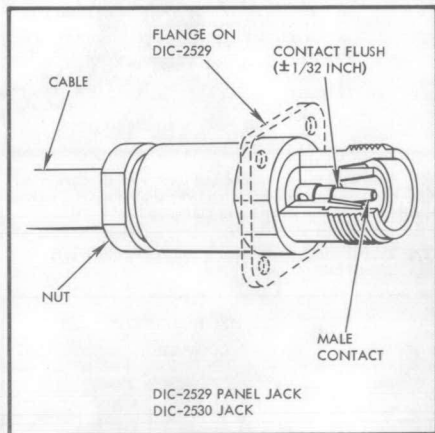
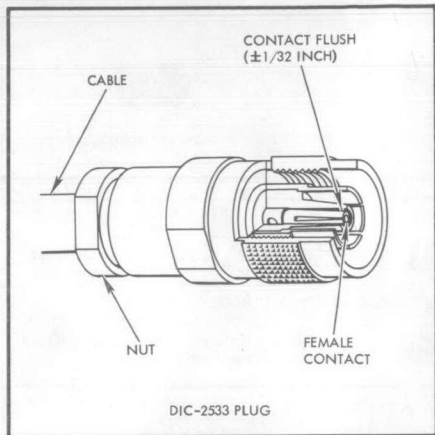
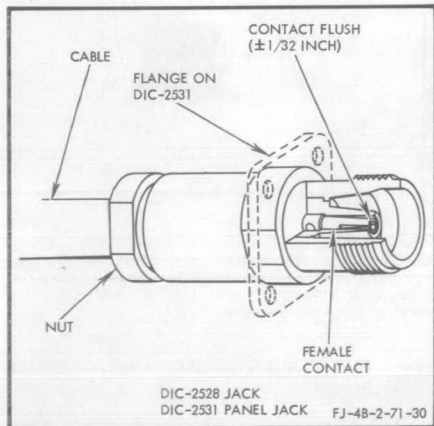
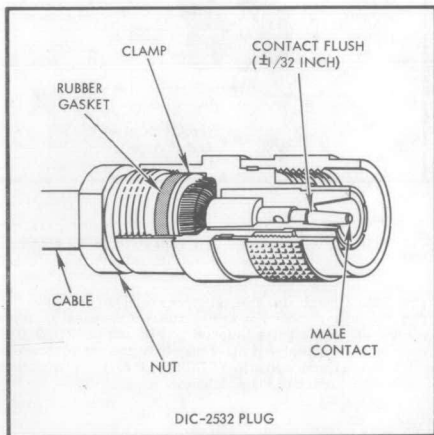
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Figure No. 9-5. Fabricating RG-9B/U and RG-87A/U Cable to DIC-2532 and DIC-2533 Connectors (Sheet 1)



**12** Insert prepared cable into plug body.

**13** Tighten nut using open end wrenches only. Hold cable and plug; then rotate nut only, otherwise shield and rubber gasket may be damaged.

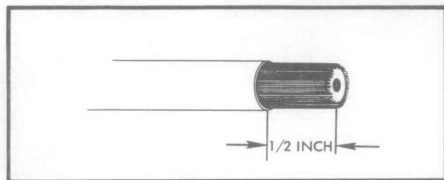


**14** Check position of center contact: on DIC-2529, DIC-2530 and DIC-2532, the contact shoulder must be flush ( $\pm 1/32$  inch) with the bottom flat in the insulation; on DIC-2528, DIC-2531 and DIC-2533, the contact must be flush ( $\pm 1/32$  inch) with the tip of the insulation. The fabrication of these connectors is such that the grooved rubber gasket is cut in two pieces when the nut is properly tightened.

*Note* If these connectors are disassembled, a new rubber gasket (MS90133-4 or equivalent) must be used in the reassembly.

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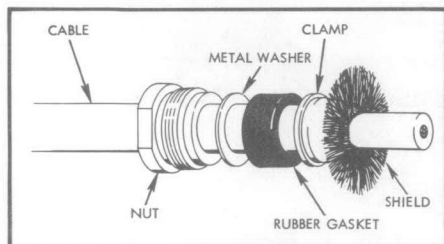
Figure No. 9-5. Fabricating RG-9B/U and RG-87A/U Cable to DIC-2532 and DIC-2533 Connectors (Sheet 2)



- 1** Cut off 1/2 inch of outer jacket to expose shielding.

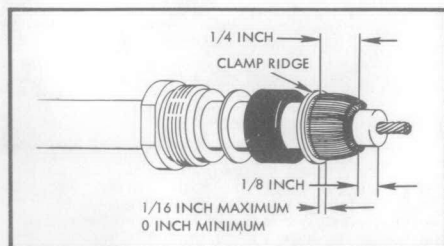
**Caution** Use care to prevent cutting shield.

- 2** Comb shielding out and taper over dielectric (plastic insulation around center conductor).



- 3** Slide nut, metal washer and thick rubber gasket over outer jacket. Slide clamp over shielding until jacket enters recess and butts lip in clamp.

- 4** Fold shielding out radially and distribute evenly around cable.



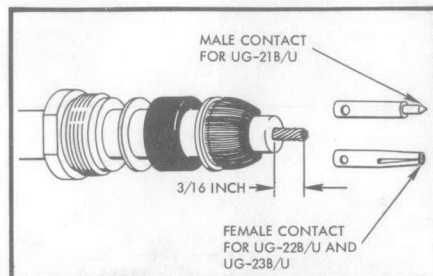
- 5** Use cutters to trim shield to 1/4 inch.

- 6** Fold shield over clamp. Shield must not lap over clamp ridge but must be within 1/16 inch of the clamp ridge.

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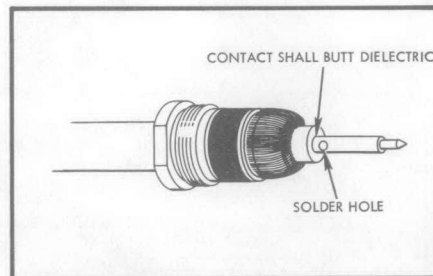
- 7** Measure 1/8 inch from folded shielding; cut dielectric from center conductor.

**Caution** Use care to prevent nicking center conductor.



- 8** Trim center conductor to 3/16 inch from dielectric.

- 9** With a small fine file, slightly round tip and sides of the center conductor to fit contact if necessary. Slide contact on until it butts dielectric. For use on RG-83/U cable only, the center contact may have the center conductor hole enlarged with a No. 37 (0.1040) drill. (Tin drilled contact hole prior to installation).



- 10** Solder contact to center conductor. Fill solder hole and contact completely. Should excess solder and rosin remain on the contact, remove with a soldering iron, or if necessary, a small fine file. Use care to prevent scoring contact plating.

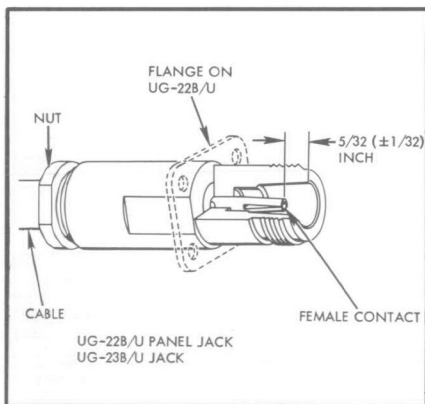
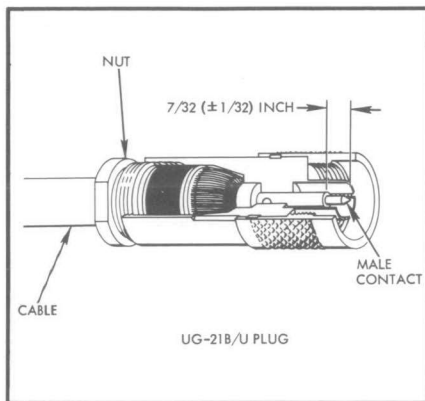
- 11** Push nut, washer and rubber gasket until they butt clamp.

FJ-4B-2-71-33

Figure No. 9-6. Fabricating RG-8A/U, RG-9B/U, RG-83/U, and RG-87A/U Cable to UG-21B/U Connectors (Sheet 1)

- 12** Insert prepared cable into plug body.

- 13** Tighten nut using open end wrenches only. Hold cable and plug body, then rotate nut only; otherwise shield and rubber gasket may be damaged.

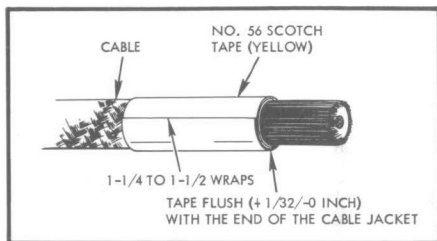


- 14** Check position of center contact on UG-21B/U. The contact shoulder should be  $7/32 (\pm 1/32)$  inch below the metal fingers in the plug body (contact point should be approximately flush with metal fingers); on UG-22B/U and UG-23B/U, the contact tip should be  $5/32 (\pm 1/32)$  inch below the tip of the jack body.

**Note** To reduce fraying on cables covered with fiberglass jackets, a plastic tape must be added to the jacket under each connector. The approved tape is "Scotch" brand electrical tape No. 56, one inch wide. It has a backing 0.001 inch thick with a yellow thermosetting adhesive.

- 1** Prepare cable as shown in figure 9-6.

- 2** Add tape prior to installation of cable clamp. The tape wrap shall be a minimum of  $1-1/4$  or a maximum of  $1-1/2$  wraps. The location shall be flush ( $+1/32/-0$  inch) with the end of the cable jacket but it shall not touch the cable shield.



- 3** Install connector clamp over tape as in original installation.

- 4** Install 10C2E conduit over the cable jacket prior to installation of connector. For rework, where the connector assembly is complete, the conduit may be split. If 10C2E conduit is not called out with the cable clamp, install three or four wraps of No. 27 Scotch (glass) tape, one inch wide, around the cable jacket immediately behind the connector.

- 5** Attach the cable clamp to the connector body with the offset sections over the flats on the connector nut. This positioning locks the nut. Use spacers between the clamp faces when specified.

- 6** Tighten all screws until the clamp is firmly attached to both cable and connector.

- 7** Inspect assembly to determine if installation is rigid.

FJ-48-2-71-34

Figure No. 9-6. Fabricating RG-8A/U, RG-9B/U, RG-83/U, and RG-87A/U Cable to UG-21B/U Connectors (Sheet 2)

FJ-48-2-71-35

Figure No. 9-7. Taping RG-87A/U Coaxial Cable for Clamp

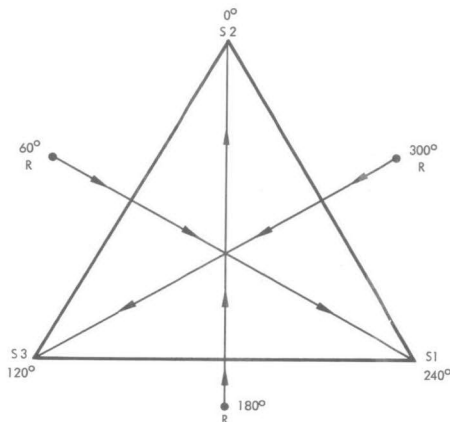


Figure No. 9-7A. Diagram for Determining Proper Synchro Connections

FJ-4B-2-51-197

#### DETERMINING PROPER SYNCHRO CONNECTIONS.

Determining the proper connections of a synchro system when a "crossed wiring" malfunction exists can be accomplished by using figure 9-7A. For example, the synchro transmitter in the adf antenna is set at 0 degrees and its rotation is clockwise. The No. 1 pointer synchro receiver of the radio magnetic course indicator reads 300 degrees and its rotation is also clockwise. In order to determine what connections must be changed to zero the No. 1 pointer receiver and maintain proper rotation, proceed as follows:

a. Place a pencil point at R 300 degrees on figure 9-7A and follow the arrows to S3. This means that reversing the rotor connections to pins "L" and "M" of the radio magnetic course indicator will cause the No. 1 pointer receiver to read 120 degrees.

b. Place a pencil point at S3 120 degrees and note the shortest distance to 0 degrees is from S3 to S2. This means that connections to pins "N" and "L" of the radio magnetic course indicator must be reversed

to make the receiver read 0 degrees. It should be understood that reversing any two stator connections will reverse the direction of rotation; therefore, connections to pins "N" and "P" must now be reversed in order to correct the rotation without changing the zero reading of the receiver.

When using figure 9-7A, always start at the point representing the reading of the synchro receiver (with the synchro transmitter at zero) and follow the arrows to 0 degrees, taking the shortest route. If the starting point on the figure is R 300, R 180 or R 60 degrees, the rotor connections must be reversed in order to arrive at a stator point on the diagram. The appropriate stator connections may then be reversed, if required. To correct rotation only, reverse S3 and S1. If figure 9-7A is used correctly, the following results will be obtained: With transmitter zeroed, the receiver reads as follows: 60 degrees—reverse R1 and R2, S1 and S2; 300 degrees—reverse R1 and R2, S3 and S2; 180 degrees—reverse R1 and R2; 240 degrees—reverse S1 and S2; 120 degrees—reverse S3 and S2.

**TEST POINT TROUBLE SHOOTING.**

To ease and expedite electrical maintenance, test point trouble shooting data has been incorporated in system trouble isolation procedures and system wiring diagrams. As any system failure or malfunction may result from any one or a combination of electrical, hydraulic, pneumatic or mechanical reasons, all probable causes (reasons) for a stated trouble are covered in the same trouble isolation chart. There are three types of test points: major, secondary and minor. Textual references to these test points are made within each system trouble shooting paragraph and the specific location of each test point may be determined by referring to the appropriate system wiring diagram in Section X. No test point designation will be duplicated nor will more than one test point designation be given to any test point.

**MAJOR TEST POINTS.**

Major test points are used to isolate a power system failure to a physical portion of the airplane or to a group of systems. Major test points are symbolized on system wiring diagrams by a star encircled Arabic numeral. Major test points are referred to in text as: test point 1, test point 2, etc. Some examples of major test points are: generator and inverter outputs, power distribution connections, etc.

**SECONDARY TEST POINTS.**

Secondary test points are used to isolate failure to a specific system or to a specific item within a system. Secondary test points are symbolized on system wiring diagrams by an encircled capital letter(s). The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Secondary test points are referred to in text as: test point A, test point AB, etc. Some examples of secondary test points are: power inputs to individual units, tie-ins with parallel or interrelated systems, sequence switches, etc. Secondary test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

**MINOR TEST POINTS.**

Minor test points are used to isolate failure within a unit. Minor test points are symbolized on system wiring diagrams by an encircled capital letter and Arabic numeral. The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Minor test points are referred to in text as: test point A1, test point A2, etc. Some examples of minor test points are: continuity through a switch or a relay that is part of a unit, resistance readings of items within a unit, etc. Minor test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

**USE OF TROUBLE SHOOTING CHARTS.**

The best trouble shooting aid is preventive maintenance and cleanliness. The next best trouble shooting aid is thorough knowledge of the theory and operation of the system in question. A thorough knowledge of the system permits rapid determination of the most likely probable cause for any given trouble and thereby reduces trouble shooting time and effort. The third most important aid is safety; observe all safety rules, check to make sure that the airplane and any attached ground power equipment is properly grounded, check to make sure that all ground safeties are installed, follow the trouble shooting instructions and if it is a two-man job, get another man to help. What is the trouble? Check the squawks, observe or perform an operational or functional check of the system in question. Check the trouble shooting charts of the system for the determined trouble. Select the most probable cause(s) and proceed to isolate the trouble; set up the system as specified in the "System Conditions" portion of the chart. Use the appropriate meters. Do not make ohmmeter tests or continuity checks on an electrically "hot" airplane. Complete check-out of the system in question without correction of the trouble may indicate that a parallel or interrelated system is at fault. If so, refer to that system for appropriate trouble shooting information. When a remedy is performed that does not correct the trouble, select the next most probable cause and continue trouble shooting. Isolation procedures are set up to require a minimum of effort. Each procedure should either isolate the trouble itself or isolate the portion of the circuit that contains the trouble. When a test point procedure is called out for an item (for example, a valve solenoid), parts of that procedure not spelled out which may lead to isolating the fault are: visual inspection for signs of physical damage, check of the ground connection or bonding and a check for good electrical connections. Similarly, when test points are called out for relay terminals, the switch section of the relay involved should be checked for proper action and continuity. The various portions of the trouble shooting charts and their functions are as follows:

- a. **TEST EQUIPMENT.** This portion of the charts contains a list of all test equipment that will be required to perform any isolation procedure that follows on the same chart.
- b. **SYSTEM CONDITIONS.** This portion of the charts specifies the desired system conditions for the tests that will follow. Some isolation procedures may require a change to these conditions; if so, the new conditions will be given in note form.
- c. **TROUBLE.** This is the observed symptom, malfunction, or fault.
- d. **PROBABLE CAUSE.** The probable cause(s) states the condition or reason causing the trouble. Probable

causes are listed in their most likely order. The probable causes may be electrical, mechanical, hydraulic, pneumatic, etc, or a combination of these reasons.

e. ISOLATION PROCEDURE. This portion of the charts is a positive statement of action. If the probable cause is nonelectrical, there will be no mention of test points; if electrical, specific directions related to one or more test points will be given. Isolation procedures are listed in their most likely or accessible order. What meter is to be used will be determined by the required meter reading(s). Use the appropriate system wiring diagram in Section X to locate test points and to perform wire segment continuity checks. Many isolation procedures require the use of test points located at a connector. In such cases, it is necessary to disengage the connector and to apply the test probe to the plug or receptacle portion of the connector as shown on the system wiring diagram. Connectors should never be disengaged with electrical power applied to the airplane. Do not damage connector sockets by inserting test probes.

f. METER READING. If the isolation procedure is nonelectrical, this portion of the chart will indicate that none is required. If test points have been specified in the isolation procedure, the value and type of reading will be stated. Resistance and voltage readings are the type most commonly required for the isolation procedures; values given will indicate their type and the corresponding type of meter should be used to obtain the reading.

g. REMEDY. For nonelectrical isolation procedures, the remedy will indicate the maintenance action required depending upon the results of the isolation procedure. For electrical isolation procedures, the remedy will indicate the maintenance action required for the meter reading obtained. Most remedies will indicate a definite maintenance action, but some remedies will indicate that further isolation procedures should be performed. Some meter readings will indicate that the airplane wiring is at fault (open or shorted) and the remedy will be to perform a wire segment continuity check. Such continuity checks should be performed so as to minimize effort. Remove power and disconnect wires as necessary; then, check for continuity at the most accessible mid point of the circuit; in this manner, several wire segments can be checked for continuity at one time.

### WARNING

Never disconnect wires or disengage disconnects with electrical power applied to the airplane. Always ground the airplane and any attached ground power equipment.

### Note

Secondary test points are listed alphabetically and opposite to each applicable wiring diagram title. Figure numbers of the wiring diagrams listed can be found in the Wiring Diagram Index of Section X of this handbook. Major test points, not listed, can be found in the Starting and D-C Generating System, the D-C Power Distribution System and the A-C Power Supply and Distribution System wiring diagrams. Minor test points, also not listed, can be found by associating them with similar secondary test points.

TEST POINT	WIRING DIAGRAM TITLE
RCA-RCZ	UHF Command Set, AN/ARC-27A, and Automatic Direction Finder, AN/ARA-25
RNA-RNZ	Radio Receiving Set, AN/ARN-14E, and Radio Set, AN/ARN-21 (Radio set, AN/ARN-14E)
RTA-RTZ	Radio Receiving Set, AN/ARN-14E, and Radio Set, AN/ARN-21 (Radio set, AN/ARN-21)
SGA-SGZ	Radar Set, AN/APG-30A, Provisions
PBA-PBZ	D-C Power Distribution System (Right-hand forward console)
PGA-PGZ	D-C Power Distribution System (Left-hand radio bay circuit-breaker panel)
XA, XAA-XAZ	A-C Power Supply and Distribution System (Phase "A" circuits)
XB, XBA-XBZ	A-C Power Supply and Distribution System (Phase "B" circuits)
XV, XVA-XVZ	A-C Power Supply and Distribution System (26-volt single-phase circuits)

FABRICATION OF JUMPER WIRES  
FOR TEST PROCEDURES.

The use of jumper wires, fabricated with pins and/or sockets from discarded plugs and receptacles in place of test probes or clamps, when trouble shooting circuits at an electrical disconnect, will prevent damage to the disconnects and ensure good electrical connections. In addition, personal safety against electrical shock will be increased. A set of jumper wires, one for each size plug and receptacle normally encountered while trouble shooting, may be fabricated so that they will be available when needed. Fabrication of jumper wires may be accomplished as follows:

a. Secure discarded plugs and receptacles of various sizes and salvage the pins and sockets.

b. Secure several lengths of wire of the proper gage for the circuit in which the jumper is to be used and the proper length to extend between the two desired points.

c. Strip and tin each end of the wires.

d. Select a pin and socket (two pins or two sockets when applicable) the same size as the plug and/or receptacles for which the jumper is to be used.

e. Insert a three-inch length of electrical insulation (item 67, materials list) on each end of the wires.

f. Solder pins and/or sockets to each end of the wires.

g. Slide electrical insulation in place over the pin and/or socket.

## COLD WEATHER MAINTENANCE OF ELECTRICAL EQUIPMENT.

Low temperature aggravates electrical and electronic maintenance problems and lowers the efficiency of servicing personnel. In general, equipment should always be serviced under as favorable conditions as possible. In this way, many borderline failures can be prevented. Prolonged exposure to cold causes servicing personnel to become clumsy. This factor can cause extensive damage to occur to equipment from being dropped and inability to properly tighten hardware. Preventive maintenance is especially valuable in preventing system failure during cold weather.

### Note

The following is a list of precautions which can facilitate preventive maintenance:

- Do not expose electrical and electronic access areas to snow or rain. Provide adequate shelter when opening access doors. Door hinges, electrical connectors, equipment fasteners, ventilated radio and radar equipment, cockpit console panels, electrical surface control actuators and, to a degree, all electrical components are extremely susceptible to failure when saturated with water condensation or ice.
- Avoid applying prying forces on cast metals and plastics such as electrical consoles, fastening strips, all electrical connectors, right-hand radio junction box, inverter and actuator mounting feet, switches, circuit breakers and electrical power and coaxial cables. These items are more brittle and are easily broken in cold weather.
- Store electrical and electronic equipment in warm areas to prevent breakdowns of electrolytic capacitors and coils inside.
- Do not use a blowtorch to preheat any electrical equipment.
- Never utilize battery power to test electrical components of any kind in cold weather. Use only a regulated external power source.
- Handle storage batteries with extreme care in cold weather. For cold weather maintenance and servicing, see figure 8-5.
- Do not overtorque bolts on electrical equipment. See figure 8-7 for correct torque values.
- Avoid breaking access seals, if possible, when operating under extreme temperature changes. In this way, condensation and frost can be minimized in the radar bay, the cockpit, radio and electrical bays and the top deck areas.

## WIRING PROVISIONS.

The primary objective of the airplane's electrical wiring system is to obtain a low loss distribution of electrical power with the greatest amount of servicing ease. To obtain this objective, materials are used which will withstand the inherent operational stresses and hazards. Wire terminations are made into either electrical and coaxial connectors or solderless-type terminals. Wire junctions are accomplished by terminal strips. Duplicate power wires are installed in certain cases as an added safety factor. Cable routing is critical and, in some locations, cables must be dressed to exactly fit into channels and other recesses in order to prevent chafing of wires against structure and equipment. If additional protection against chafing is necessary, insulated tubing and strips may be used as follows:

MATERIAL		TEMPERATURE
Flexible plastic tubing (Surcol)	Item 67, Materials List	Below 160°F
Semi-rigid amber tubing	Item 136, Materials List	Below 160°F
Cotton sleeving tubing	Item 68, Materials List	Below 160°F
Glass fiber sleeving tubing (silicone impregnated)	Item 68, Materials List	High temperature
Pressure-sensitive tape	Item 127, Materials List	High temperature
Glass tape	Item 127, Materials List	High temperature
Corprene tape	Item 125, Materials List	Low temperature
Vinyl tape	Item 129, Materials List	Low temperature

When repairing wiring, the original installation should be duplicated if possible. Excessive use of any of these materials should be avoided and, where tubing is split, it should be spot-tied with applicable cord such as linen cord (item 37, materials list) or nylon cord (item 123, materials list) for low temperature areas, or Varglass cord "46" (item 137, materials list) or glass tape (item 127, materials list) for high-temperature areas. These cords are also applicable to spot-tie electrical cables without using insulated tubing. Temperature classification is also effective on hookup wire. The following types of wire are applicable for temperature areas as shown:

Specification MIL-W-5086	Below 160°F
Specification MIL-W-7139	160° to 400°F
AF-32659	400° to 750°F

## REPAIR OF WIRING.

When it is necessary to repair or replace airplane electrical wiring, only standard wiring and approved hardware must be used. It is preferable to use wire fabricating tools from the manufacturer of the terminals being



used. Figures 8-13 and 8-14 show the applicable numbers of AN-type solderless terminals and the tools which are approved for the operation. Extreme care must be exercised in preparing wires for lugging so that the repair will be permanent and trouble free.

#### Note

The following instructions should be closely adhered to:

- Duplicate the original installation as closely as possible.
- Always use the approved wire, terminal and tool.
- Be careful to avoid nicked or broken strands in the wire. Do not use a wire stripper whose cutting edges overlap when the tool is squeezed together.
- Always crimp terminals with flat sides parallel to eyelet.
- Never ream terminal holes to fit larger screws than intended. Reamed holes weaken the terminals and reduce contacting surface, causing heat.
- Install terminals so that bending is not required for clearance in tight places. A maximum of one 90-degree bend is allowable during the life of a terminal (sizes No. 10 and smaller, larger sizes must not be bent more than 30 degrees).
- Use only copper terminals with copper wire and aluminum terminals with aluminum wires. Failure to observe this precaution will result in corroded terminals and poor contact.
- Do not use steel hardware in a current path. If buffer hardware is necessary on terminals, always use unpainted aluminum washers or plated brass nuts.
- Always provide adequate wire identification numbers on new wires (no less than one number, 6 inches from each end).

#### APPLICATION OF RAIN EROSION-RESISTANT COATING TO VERTICAL STABILIZER TIP.

##### BRUSH APPLICATION OF COATING.

To apply rain erosion-resistant coating by brushing, proceed as follows:

- a. Scuff sand the surface to be coated to remove any surface glaze and wipe clean with a cloth dampened with toluene (item 132, materials list).
- b. Apply a light squeegee coating of filaplast filler (item 50, materials list) to fill any holes or dents.

c. Bake the part with the filler applied for 2 hours at 80°C to 94°C (175°F to 200°F).

d. Carefully sand to remove any high spots of filler.

e. Brush on two coats of undiluted cement (item 15, materials list) allowing 5 minutes drying time between coats.

f. Scuff sand to remove any rough surface.

g. Prepare topcoat base cement (item 16, materials list) by mixing with accelerator (item 1, materials list) in proportion of one gallon of base cement to 316.8 cc of accelerator. Dilute this mixture with 30 percent toluene for better brushing consistency.

#### Note

Do not mix more solution than will be used within 12 hours since this is its maximum useful life.

h. Brush the accelerated cement with a minimum number of strokes. Avoid brushing over partially dried areas to reduce pulling and entrapment of air bubbles. Keep the brush well wet with cement solution and, if desired, a small amount of toluene.

i. Immediately after the area has been coated with cement, dip the brush in toluene and brush lightly over any areas where bubbles can be seen. Continue brushing until all bubbles are removed.

j. Allow approximately 30 minutes air drying between coats of cement.

k. Repeat application of the cement until a coating of between 0.008 and 0.012 inch is obtained. This requires approximately six or seven coats of the cement.

#### Note

The first three or four coats should be applied thinly to avoid sags while the subsequent coats can be put on more heavily.

l. Allow the final coat to dry until entirely tack-free before handling. The cement film should be allowed to cure for 72 hours.

#### SPRAY APPLICATION OF COATING.

To apply rain erosion-resistant coating by spraying, proceed as follows:

a. Perform steps a. through f. of paragraph, Brush Application of Coating.

b. Mix top coat base cement (item 16, materials list) with accelerator (item 1, materials list) in the proportion of one gallon of cement to 316.8 cc of accelerator. Dilute this mixture in the proportion of one part of accelerated cement to two parts of solvent (item 118, materials list). Mix thoroughly.

c. Apply the accelerated and diluted cement to the area to be coated. The following equipment is recommended, although equivalent equipment may be used: Binks Spray Gun No. 19 with a pressure cup and a 67P nozzle (a cup pressure of 20 psi and line pressure of 30 psi).

d. Immediately after the area has been given a coat of cement, apply another spray of solvent (item 118, materials list) to remove any air bubbles and to lessen any orange peel effect.

e. Repeat the application of cement, allowing approximately 15 to 20 minutes drying time between coats until a coating of between 0.008 and 0.012 inch is obtained. This requires approximately 18 coats.

**Note**

● A thickness check can be made by coating and measuring a piece of aluminum or aluminum foil at the same time the part is being coated.

● Apply the first few coats very thinly to avoid sags. The later coats may be applied more heavily, but extreme care must be taken to prevent sagging.

f. Allow the final coat to dry tack-free before handling. The cement film should be allowed to cure for 72 hours.

CONSUMABLE MATERIALS

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
1	Accelerator	983C	Goodyear Tire and Rubber Co., Inc.	
15	Cement, General Purpose, Synthetic Base	MIL-C-4003		
16	Cement, Top coat Base	1801C	Goodyear Tire and Rubber Co., Inc.	
37	Cord, Linen	MIL-C-2520		
50	Filler, Tuf-on Filaplast	P-24A	Brooklyn Varnish Manufacturing Co.	CAT-A-LAC White Filler Putty No. 476-2 (Finch Paint and Chemical Co., Torrance, Calif.)
67	Insulation, Electrical (Surco)	MIL-I-631		
68	Insulation Sleaving, Electrical, Flexible, Treated	MIL-I-3190		
115	Soap, Castile	MIL-S-4282		
118	Solvent	1803C	Goodyear Tire and Rubber Co., Inc.	
123	Synthetic Fiber, Nylon Cord	MIL-C-572		
125	Tape, Adhesive, Rubber and Cork Composition	MIL-T-6841		
127	Tape, Glass Cloth, Pressure-sensitive, Flame-proof	MIL-P-4053		
129	Tape, Vinyl	No. 473	Minnesota Mining and Mfg. Co.	
132	Toluene	JAN-T-171; Stock No. W5610-281-2005		
136	Tubing, Semi-rigid Amber	NA2-4172	North American Aviation, Inc.	

**RADIO COMMUNICATION SYSTEMS****9-1. RADIO COMMUNICATION SYSTEMS.**

9-2. Two-way radio communication is maintained by the uhf command set, AN/ARC-27A. Reception of audible navigational aid signals is accomplished in the vhf spectrum by the omni-range receiver, AN/ARN-14E, and in the uhf spectrum by the radio set, AN/ARN-21.

9-3. UHF COMMAND SET, AN/ARC-27A.

9-4. The uhf command set, AN/ARC-27A, is a remotely controlled radio receiver-transmitter which can be tuned to any of 1750 channels within the frequency range of 225.0 through 399.9 megacycles. A guard or

stand-by channel is also provided for constant monitoring. Transmission and reception are amplitude modulated, on the same frequency and use the same antenna, AS-786/A. This antenna is also common to the radio set, AN/ARN-21, when it is installed. Switching from receiving to transmitting conditions is accomplished by pressing the mike button (MIC) on the power control lever. The pilot's microphone and headsets are plugged into the system at the pilot's oxygen tube assembly. Automatic noise limiting is controlled by a master squelch control on the receiver-transmitter and a vernier on the radio control panel, located on the right-hand console. The uhf command set consists of the following equipment:

EQUIPMENT	LOCATION	FUNCTION
<b>UHF COMMAND SET, AN/ARC-27A, consisting of:</b>		<b>Provides air-to-air and air-to-ground radio communication.</b>
Receiver-Transmitter, RT-178/ARC-27	Right-hand radio bay.	
Receiver-Transmitter Mount, MT-822/ARC-27	Right-hand radio bay.	
Radio Set Control, C-1703/ARC-27A	Right-hand console.	
UHF Command Set Antenna, AS-786/A	Vertical stabilizer tail cap.	
Antenna Relay, RE-120/ARA-25	Upper center radio bay.	

The uhf command set is also used to provide signals for the automatic direction finder set, AN/ARA-25. When the automatic direction finding equipment is operated, the uhf receiver-transmitter is connected to the direction finder set antenna, AS-578A/ARA-25. (Refer to paragraph 9-32.)

**9-5. FUNCTION OF UHF COMMAND SET, AN/ARC-27A.**

9-6. The receiver-transmitter, RT-178/ARC-27, provides transmitting and receiving facilities on any one of 1750 frequency channels (225.0 through 399.9 megacycles in steps of 0.1 megacycle). Twenty channels are pretuned, using a memory circuit contained in the radio set control, C-1703/ARC-27A. The guard channel is also pretuned by the radio set control, C-1703/ARC-27A. The

receiver-transmitter incorporates monitoring provisions on its front panel so that a microphone, headsets and a test meter may be connected locally while adjustments are being made. (Refer to paragraphs 9-33 and 9-36.) A switch is provided on the receiver-transmitter front panel to enable the adjustment and check of the receiver and transmitter portions of the unit by reading plate and antenna current values. The receiver-transmitter unit is contained in an airtight case which is pressurized to enable efficient operation in the rarefied air of high altitudes. Power requirements of the uhf command set are supplied by the d-c secondary bus through the ARC-27 circuit breaker. Vacuum tube heaters are powered directly by 27.7 volts dc, while plate current is supplied

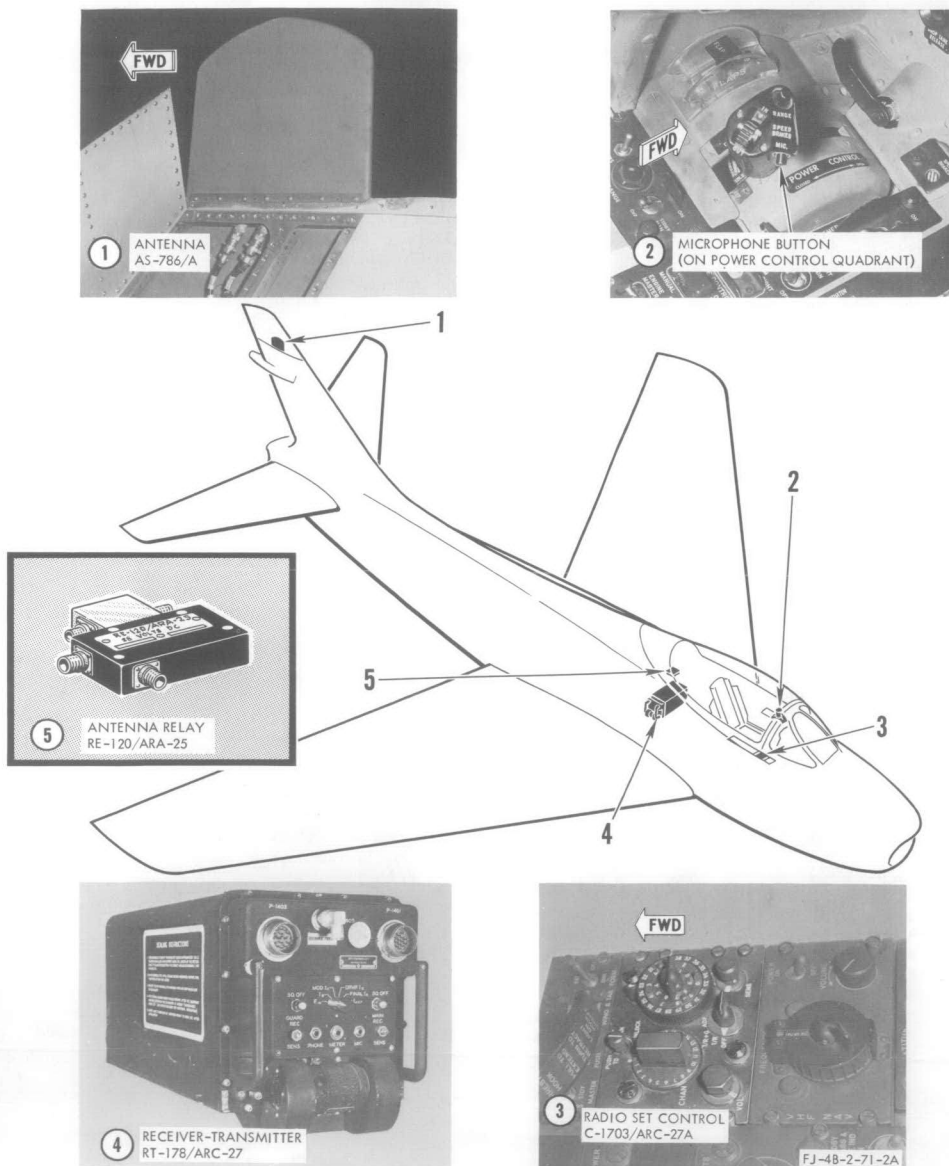


Figure No. 9-8. UHF Command Set, AN/ARC-27A, Locator

by the dynamotor. In normal radio operation, the antenna relay, RE-120/ARA-25, connects the uhf command set antenna, AS-786/A, to the input of the receiver-transmitter. When the function switch on the radio set control, C-1703/ARC-27A, is positioned to "ADF" the antenna relay coil is energized, connecting the automatic direction finder antenna, AS-578A/ARA-25, to the receiver-transmitter input, and the transmitter function is disabled.

#### 9-7. TROUBLE SHOOTING UHF COMMAND SET, AN/ARC-27A.

9-8. Trouble shooting in the uhf command set is limited while the components are in the airplane. Certain checks should be made, however, before any components are removed. Preliminary diagnosis of typical system malfunctions may be performed by consulting the following chart:

TEST EQUIPMENT: D-C voltmeter.  
Ohmmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.  
ARC-27A circuit breaker engaged.  
ADF not selected.  
Set for any channel.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>NO TRANSMITTING OR RECEIVING.</b>			
Defective power input wiring.	Check test point RCM to ground.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts dc.	Replace defective power wire.
Defective circuit breaker.	Check test point PGG to ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
Defective antenna transfer relay.	Check between test points RC1 and RC2.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective relay.

TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: 28-volt d-c power applied to airplane.  
ARC-27 circuit breaker engaged.  
ADF not selected.  
Set for any channel.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>CAN RECEIVE BUT CANNOT TRANSMIT.</b>			
Defective MIC. switch or wiring.	Check between test points RCM and RCN.	28 volts dc.	Continue trouble shooting.
		Other than 28 volts dc.	Perform wire segment continuity check through MIC. switch to ground and replace defective wire or switch as required.

#### Note

For further trouble shooting and maintenance instructions, refer to Handbook of Service Instructions, Radio Set, AN/ARC-27A.

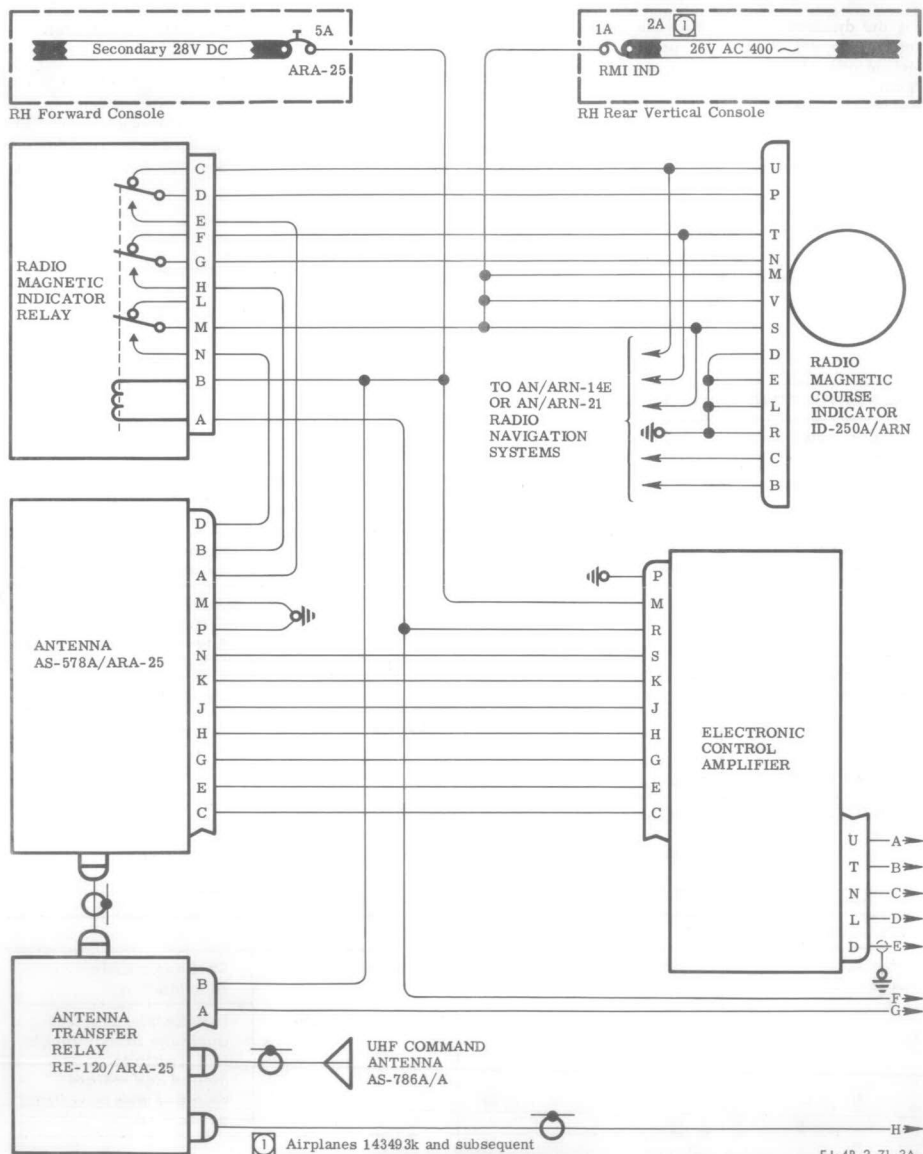
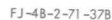


Figure No. 9-9. UHF Command Set, AN/ARC-27A, and Automatic Direction Finder Set, AN/ARA-25, Schematic (Sheet 1)



Revised 1 February 1958

9-9. OPERATIONAL CHECK OF UHF  
COMMAND SET, AN/ARC-27A.

9-10. To perform an operational check of the uhf command set, proceed as follows:

**WARNING**

Operation of this equipment involves the use of high voltages which are dangerous to life.

Operating personnel must at all times observe all safety regulations.

a. Loosen fasteners securing right-hand radio bay access door. Raise and secure door in open position.

b. Disconnect antenna cable from receiver-transmitter and connect ME-11/U wattmeter to antenna jack of receiver-transmitter through 10 feet of RG-8/U coaxial cable.

c. Connect headset to jack on face panel of receiver-transmitter.

d. Apply 27.7-volt d-c external power source to airplane.

**CAUTION**

Place the D.C. POWER switch in "OFF" position while servicing the airplane with external power.

e. Place function switch on control panel to "T/R" position. Place CHAN selector switch to channel "1."

**CAUTION**

Do not turn equipment off and on rapidly. High starting current used may cause arcing of the power relay contacts if the contacts are drawn apart during the starting period. Allow 60 seconds for equipment to warm up.

f. Place SENS control on control panel to maximum counterclockwise position.

g. Place VOL control in maximum position.

h. Cycle through all preset channels without disturbing the sensitivity controls on the receiver-transmitter.

i. On each channel depress the SQ OFF—MAIN REC button on the receiver-transmitter. Noise should be audible with button depressed and should disappear when button is released.

j. Place function switch on control panel to "T/R+G" position.

k. With SENS control in the maximum counterclockwise position and the VOL control in the maximum

position, cycle through all preset channels without disturbing the sensitivity controls on the receiver-transmitter.

l. On each channel, depress the SQ OFF—GUARD REC button on the receiver-transmitter. Noise should be audible with button depressed and should disappear when button is released.

m. If it is found necessary to change the setting of the sensitivity controls on the receiver-transmitter to prevent noise after performing the preceding steps, proceed as follows: (1) Place sensitivity controls maximum clockwise. (2) Rotate the VOL control on control panel clockwise. (3) Depress the SQ OFF—MAIN REC button on receiver-transmitter. Noise should be heard in headset. (4) Depress the SQ OFF—GUARD REC button on receiver-transmitter. Noise should be heard in headset. (5) With either button depressed, rotation of the VOL control should control the volume of the noise. (6) Rotate the MAIN REC and the GUARD REC sensitivity controls counterclockwise until the noise in the headset is removed. (7) With no signal input, adjust the receiver-transmitter sensitivity controls (on the noisiest channel) to the point just before the squelch opens.

n. Remove headset from receiver-transmitter and connect microphone and headset to jacks on pilot's oxygen tube assembly.

o. Place function switch to "T/R" position. Place CHAN selector switch to channel "1."

p. Depress microphone switch button (MIC) on power control lever and speak into the microphone. The speaker's voice should be audible in the headset and the ME-11/U wattmeter should indicate a minimum of 9 watts.

q. Rotate CHAN selector switch to channel "2" and repeat step p. Check all channels in this manner.

**Note**

Release microphone switch button before changing channels.

r. Change function switch to "T/R+G" position. Place CHAN selector switch to channel "1."

s. Perform operations as described in steps p. and q.

t. Turn equipment off and disconnect external power source.

u. Remove ME-11/U wattmeter and restore antenna cable to receiver-transmitter and safety cable connector.

v. Close and secure right-hand radio bay access door.

w. Start engine and operate at a speed sufficient to operate the receiver-transmitter on generator power.

x. Turn on uhf command set and adjust for reception on several channels and guard channel. Turn on all equipment normally operated in flight.

y. Conduct a communication test with the applicable radio facility, for the purpose of checking proper communication and frequency setting on each preset channel.

z. Turn function switch to "OFF" and secure engine.

aa. Remove microphone and headset.



Test meter readings are made by inserting a test meter plug into the METER jack. Precision multiplier resistors are incorporated in the test circuit to allow readings to be

made with a 0-1 milliammeter, Type TS-80/U or equivalent. Both receiving and transmitting condition readings are shown in the following test meter reading chart:

METER SWITCH POSITION	METER READING— RECEIVING	METER READING— TRANSMITTING	MULTIPLY BY
$E_{IN}$	0.54-0.56	0.54-0.56	50 v
$I_D$ guard off	0.24-0.28	0.4-0.54	1000 ma
$I_b$ guard on	0.30-0.34	0.4-0.54	1000 ma
MOD $I_K$ unmodulated	0	0.25-0.4	200 ma
MOD $I_K$ modulated	0	0.5-0.7	200 ma
DRIVER $I_G$	0	0.3-0.8	50 ma
FINAL $I_G$	*	0.4-1.0	50 ma (approx.)
$I_{ANT}$	0	0.3-0.95	25 w (approx.)

\*A residual current will be read here because of a voltage divider in the power amplifier stage. The reading does not indicate grid current through the tube.

9-11. ADJUSTING PRESET CHANNELS. To adjust the 20 preset channels, proceed as follows:

- Set function switch on radio set control, C-1703/ARC-27A, to "OFF."
- Set CHAN selector to the channel number to be preset.
- Set three frequency selector knobs to frequency desired to be preset on that channel.
- Turn the PUSH-TO-SET CHAN button one-quarter turn clockwise and depress button firmly. It is important that each time a channel is preset, this button be fully depressed.

#### Note

The inscribed white line on the PUSH-TO-SET CHAN button must return to a vertical position. If this does not occur when the button is released, the channel is not properly set and the procedure must be repeated.

- After all channels have been preset to the desired frequencies, check operation of radio set in transmitting and receiving conditions.

#### Note

If the autopositioner mechanism fails to "set up" on any of the channels, the trouble could be caused by a defective control, C-1703/ARC-27A. If no control panel is available for replacement, use the following procedure: turn CHAN selector switch to "M" (manual) and tune the desired frequency by manually adjusting the three frequency knobs on the control panel. This is an interim fix only, and the control panel must be replaced when a replacement part is available.

#### 9-12. UHF COMMAND SET RECEIVER-TRANSMITTER, RT-178/ARC-27.

9-13. The receiver-transmitter consists of ten plug-in subassemblies on a main chassis, enclosed in a sealed aluminum case. The case acts as an electrical shield, a pressurized container and a heat exchanger. The case is pressurized to between 3 and 5 psi by means of one of two air valves located on the front panel. It is imperative that the receiver-transmitter maintain its case pressure; otherwise, the set is useless at high altitudes where the transmitter signal will arc across the final amplifier tank circuit. For pressurizing information, refer to paragraph 9-16. A blower motor with two rotor fans forces outside air along the passage between the inner and outer shells of the case to provide adequate ventilation. All external connections are made through pressure sealed connectors mounted on the front panel. The front panel also contains master sensitivity controls for the main and guard

## Section IX Radio Communication Systems

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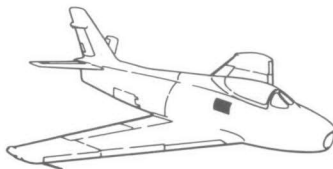
channel receivers, with SQ OFF buttons to disable the squelch circuits and to check sensitivity. Jacks are also provided for the microphone, headsets and a test meter. For further details, refer to paragraph 9-9. Electrical characteristics are as follows:

27.7-VOLT D-C CURRENT REQUIREMENTS
16.5 amperes — receiving
19.1 amperes — transmitting
25.5 amperes — channel switching
120.0 amperes maximum — starting surge
RECEIVER OUTPUT
50-milliwatt output at 5-microvolt input, 30 percent modulated at 1000 cycles (maximum 2 watts)
RECEIVER SELECTIVITY
6-decibel attenuation at 85 kilocycles off resonance
60-decibel attenuation at 300 kilocycles off resonance
FREQUENCY STABILITY
0.005 percent
TRANSMITTER OUTPUT
9 watts — 225.0 to 399.9 megacycles, modulated to 90 or 95 percent
CHANNEL SELECTION TIME
8 seconds maximum
TRANSMIT—RECEIVE INTERVAL
100 milliseconds maximum

Receiver operation is a variation of superheterodyne circuit using three mixers: the first converting from signal frequency to a 20—30 megacycle intermediate frequency; the second mixer converting from 20 to 30 megacycles to a 4.8—5.7 megacycle intermediate frequency; and the third mixer converting from 4.8 to 5.7 megacycles to 3.45 megacycles intermediate frequency. Audio detection and noise limiter operation are performed from the 3.45 megacycle intermediate frequency. The audio amplifier, which is used in normal receiver operation, is also tied into the squelch system. A high-fidelity amplifier, operating directly from the audio detector and noise limiter, sends a signal to the automatic direction finder system, AN/ARA-25, when used. In transmitter operation, the signal to be transmitted originates from a 3.45-megacycle oscillator and 9.15—8.25 megacycle oscillator beating together into the first mixer. The signal is then fed to a 4.8—5.7 megacycle intermediate frequency and, subsequently, converted a second and third time before reaching the final transmitted frequency. The transmitter is plate-modulated at the final amplifier. An elaborate channel selector system is used to automatically synchronize the tuned circuits within the following subassemblies:

- Spectrum amplifier tuners.
- Main receiver r-f amplifier tuners.
- Pre-amplifier tuners.
- Power amplifier tuners.
- 20—30 megacycle i-f tuning slug rack.

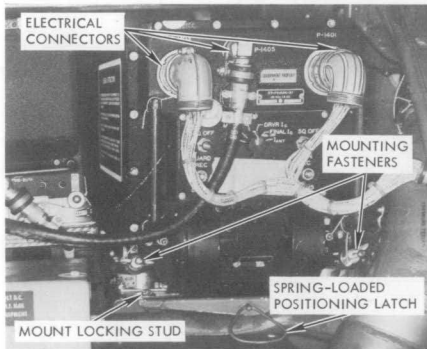
## 9-14. REMOVING AND INSTALLING UHF COMMAND SET RECEIVER-TRANSMITTER, RT-178/ARC-27.



### REMOVING

**Caution** Make certain no power is applied to system.

- 1** Open and support right-hand radio bay access door.
- 2** Disconnect three electrical connectors on face of unit.



- 3** Loosen two mounting fasteners at lower corners on face of unit and disengage from feet on receiver-transmitter.
- 4** Loosen mount locking stud. Pull spring-loaded positioning latch and swing front of receiver-transmitter mount aft to allow "RT" unit to be pulled straight out.

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- 5** Slide receiver-transmitter carefully outboard on mount and remove from airplane.



RECEIVER-TRANSMITTER, RT-178/ARC-27



MOUNTING FEET

**INSTALLING**

**Caution** Make certain no power is applied to system.

- 1** Position unit on mount.
- 2** Push unit inboard until seated on mount.
- 3** Swing mount forward so that spring-loaded positioning latch falls into detent.
- 4** Tighten two fasteners at lower corner flanges on face of unit and safety with AN995F32 wire.
- 5** Connect and safety-wire three electrical connectors on face of unit.
- 6** Close radio compartment access door.

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### 9-15. REMOVING AND INSTALLING UHF COMMAND SET RECEIVER-TRANSMITTER MOUNT, MT-822/ARC-27.

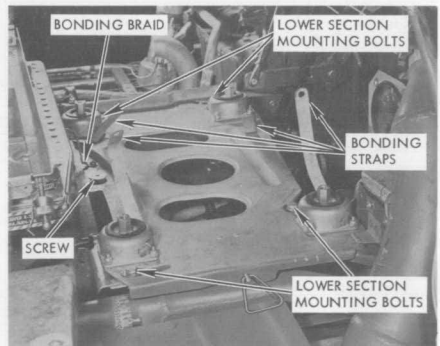
**REMOVING**

- 1** Remove four bolts in corners of upper section of mount and lift off upper section of mount.



- 2** Remove four bolts, washers and spacers in corner of lower section of mount and one screw, washer and spacer in aft center of lower section of mount.

- 3** Remove bonding braid from lower section of mount. Be careful not to bend bonding straps. Remove lower section of mount.

**INSTALLING**

- 1** Place lower section of mount in mounting position.
- 2** Secure bonding braid.
- 3** Secure lower section to structure with one screw and four bolts, washers and spacers.
- 4** Secure upper section of mount to lower section with four bolts and lock washers. Make certain that bonding straps are connected at each corner.

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9-16. **PRESSURIZING RECEIVER-TRANSMITTER, RT-178/ARC-27.** Two pressurizing valves are provided on the receiver-transmitter, RT-178/ARC-27, one on each side of the front panel, adjacent to the front mounting feet. Proper pressurizing of the unit should consist of periodically changing the air in the unit. This may be accomplished in the following manner:

- a. Remove core of one valve and connect pressurizing unit, MK-20A/U, or equivalent, to other valve.
- b. Release air from pressurizing unit into receiver-transmitter until internal air has been changed.
- c. Reinstall valve core in open valve and pressurize unit to between 13 and 15 pounds above atmospheric pressure as indicated on a Schrader 3715 gage, or equivalent.

**CAUTION**

Do not exceed 15 pounds pressure in the unit. Damage to inner components may occur if this value is exceeded.

- d. Check for case and valve leakage. Pressure drop should not exceed one pound in 12 hours. If pressure drop is normal, reduce pressure to between 3 and 5 pounds and perform operational check of radio set. (Refer to paragraph 9-9.)

If the receiver-transmitter case shows excessive leakage, check for location of leaks by painting case seams and electrical connector inserts and shell edges with leak detecting solution (item 115, materials list). Be careful when painting shell inserts that pins are not touched with the solution since a film may be left on them which could prevent good electrical contact. When a unit needs to be resealed, proceed as follows:

- a. Remove receiver-transmitter from airplane and place in vertical position with front casting handles against top surface of bench.
- b. Examine the gasket around front of case and electrical connectors to determine location of leak.
- c. Depressurize unit completely.
- d. Using No. 8 Allen wrench, loosen 16 bolts which hold case to front panel, also four screws on bottom of front casting. Bottom screws are obscured by parts of blower assembly.
- e. Lift main chassis out of case and lay on bench in horizontal position. Be very careful not to stretch gasket out of its channel, or to tear the gasket.
- f. To reassemble, insert chassis part way in case and apply light coat of petrolatum to gasket before sealing. If it has been determined that a leak exists around the inside of an electrical connector, do not attempt to repair the leak without having proper seals and equipment.

9-17. **SERVICING AND MAINTENANCE OF UHF COMMAND SET RECEIVER-TRANSMITTER, RT-178/ARC-27.** Basic maintenance and servicing of the

uhf command set usually requires that the receiver-transmitter unit be removed from the airplane. An efficient job of locating trouble in the radio set must depend upon the ingenuity of the technician and his familiarity with the circuits involved. In general, a quick check for open heaters and plate voltage to the various subassemblies of each component will provide a starting point for trouble shooting. Individual tube socket potentials may be checked and compared with optimum socket voltage and resistance values. If failure is only partial, or if the set fails to meet operational check requirements, the trouble may be localized by noting at which points the grid driving voltages are low or abnormal. In cases of abnormal grid current in a stage, a defective tube may be suspected. Do not depend upon a purely emission-type tube tester to determine tube condition since a gaseous condition within the tube envelope, which may not be apparent on an emission test, would upset avc and driving voltages and, thus, cause equipment malfunction or failure. The tubes in the receiver-transmitter have series paralleled filament strings. It is possible to isolate which string contains a tube with an open filament by noting a significant difference in glow of any tubes with respect to the others. Do not pull tubes out of their sockets for checking until circuit power is turned off. Unbalance in current caused by a burned out tube filament can cause other tubes to burn out also. If the radio set is malfunctioning on a certain channel only, it can usually be assumed that a condition other than tube trouble is present. Also, it is not advisable to replace tubes in a tuned circuit, especially the 20—30 megacycle, i-f spectrum amplifier or r-f amplifier, without realigning the stages after the tube is replaced.

9-18. **UHF COMMAND SET CONTROL, C-1703/ARC-27A.**

9-19. All operational controls for the uhf command set, except the microphone switch, are located on the radio set control, C-1703/ARC-27A. The control functions consist of the following:

NAME OF CONTROL	FUNCTION
RADIO SET CONTROL, C-1703/ARC-27A	
<b>OFFT/R/T/R+G ADF</b>	<b>Function switch.</b> Positions are as follows: <b>OFF</b> UHF command set off. <b>T/R</b> Main receiver on. <b>T/R+G</b> Main and guard receiver on. <b>ADF</b> Receiver-transmitter connected for automatic direction finding with AN/ARA-25.
<b>CHAN</b>	<b>Channel selector switch.</b>
<b>PUSH-TO-SET CHAN</b>	<b>Used during presetting of channels.</b>
<b>VOL</b>	<b>Adjusts audio output level of receiver.</b>

NAME OF CONTROL	FUNCTION
RADIO SET CONTROL, C-1703/ARC-27A (Cont)	
SENS	Controls sensitivity of receiver on guard and main receiver channels.
Frequency selector knobs	Set up operating frequency for both manual and memory circuit tuning.

By placing the CHAN selector switch to "M," any channel within the operating range may be tuned manually on the frequency dials without being identified with a channel switch number. Each of the 20 channels may be set up to a specific frequency as described in paragraph 9-11.

9-20. REMOVING AND INSTALLING RADIO SET CONTROL, C-1703/ARC-27A. To remove control panel, proceed as follows:

**CAUTION**

Make certain that no power is being applied to system.

a. Using an offset screwdriver of suitable size, loosen dzus fasteners on exterior lights control panel, lift panel out of console and position so that it does not obstruct removal of uhf command set control panel.

b. Loosen dzus fasteners on uhf command set control panel and lift panel sufficiently to gain access to electrical connector.

c. Cut safety wire on connector and remove connector and panel.

**CAUTION**

Place dirt excluder caps on open cable connectors if panels are not to be replaced immediately.

To install control panel, proceed as follows:

**CAUTION**

Make certain that no power is being applied to system.

a. Gain access to stowed cable and install cable connector on uhf command set control panel. Safety-wire connector with AN995F32 wire.

**Note**

Before attempting to install uhf command set control panel, make certain that the exterior lights control panel is removed from its position on the console since the uhf control panel cannot be installed with both adjacent panels in place.

b. Install uhf command set control panel and secure to console.

c. Install exterior lights control panel and secure to console.

d. Perform operational check of uhf command set, AN/ARC-27A, and interior and exterior lighting systems.

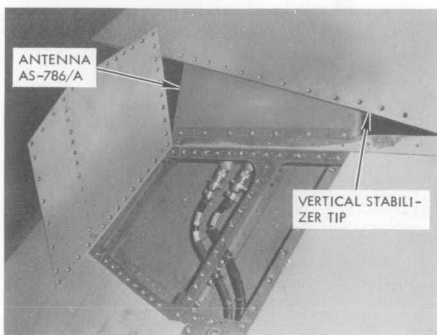
9-21. SERVICING AND MAINTENANCE OF RADIO SET CONTROL, C-1703/ARC-27A. Information for servicing of radio set control, C-1703/ARC-27A, is not within the scope of this handbook. In cases of stiff operation of controls, it should not be assumed that the malfunctioning component requires lubrication until a careful diagnosis is made. The utmost care must be used when the component is lubricated, otherwise a more serious malfunction will occur from excessive lubrication. Adjustment of any portion of the controls must be made according to approved instructions.

9-22. UHF COMMAND SET ANTENNA, AS-786/A.  
9-23. The uhf command set antenna, AS-786/A, is located on the top rib of the vertical stabilizer and is covered by the vertical stabilizer tip. The antenna is a duplex antenna with radiating efficiency at optimum for both the uhf command set, AN/ARC-27A, and the radio set, AN/ARN-21, when installed. The antenna portion which matches the uhf command set is a dipole encased in fiberglass.

9-24. REMOVING AND INSTALLING UHF COMMAND SET ANTENNA, AS-786/A.

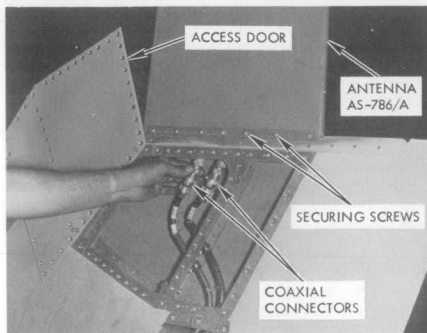
REMOVING

- 1 Remove vertical stabilizer tip.
- 2 Open antenna disconnect access door.



- 3 Disconnect two coaxial cable connectors and clamps from antenna.

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- 4 Remove screws securing antenna to structure and lift off antenna.

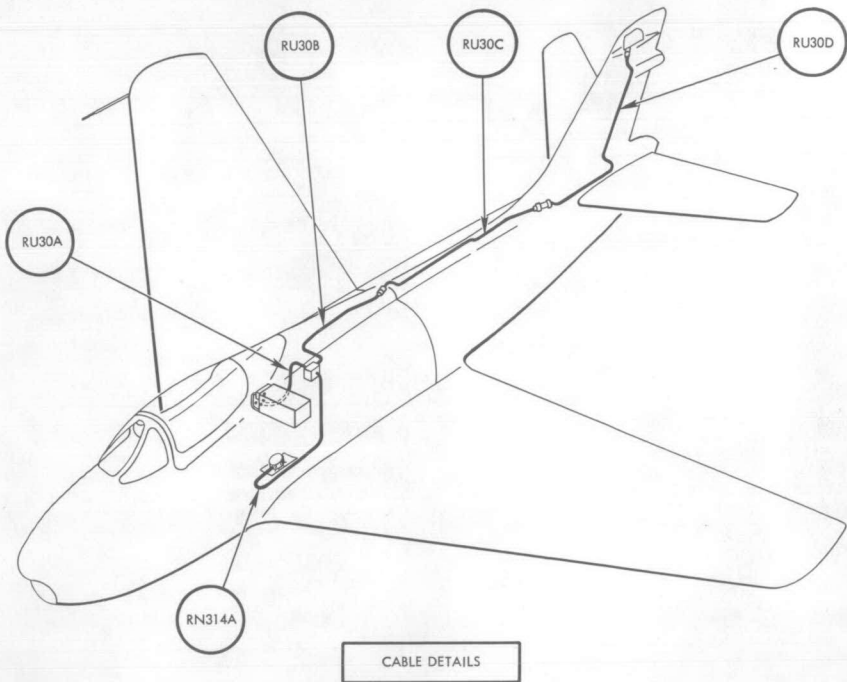
INSTALLING

- 1 Position antenna in place and secure with screws at base of antenna.
- 2 Connect and safety two coaxial cable connectors and clamps.
- 3 Replace vertical stabilizer tip.
- 4 Replace antenna disconnect access door.

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9-25. UHF COMMAND SET COAXIAL CABLES.

9-26. The coaxial cables connected between the antenna and the receiver-transmitter are shown in figure 9-10. When it becomes necessary to repair coaxial cables, always follow fabricating instructions as shown in the General Information paragraphs of Section IX.



CABLE NUMBER	IDENT	FORWARD CLAMP	CONNECTOR TYPE (FORWARD)	CABLE TYPE	CUT CABLE LENGTH (INCHES)	CONDUIT	CONNECTOR TYPE (AFT)	AFT CLAMP
RU30A	DUPLICATE ORIGINAL	5C12	UG-21B/U	RG-98/U	58-1/2	8C7B8-31-1/2	UG21B/U	5C12
RU30B	DUPLICATE ORIGINAL	5C12	UG-21B/U	RG-87A/N	116-1/2	8C7B8-16	D1C2531	5C12
RU30C	DUPLICATE ORIGINAL	5C12	D1C2531	RG-87A/U	105	10C2E9-18	D1C2532	5C12
RU30D	DUPLICATE ORIGINAL	5C12	D1C2532	RG-98/U	138	10C2E9-21 8C7B8-26	D1C2532	5C12
RN314A	DUPLICATE ORIGINAL		UG-21B/U	RG-98/U	187	8C7-8-19	UG-21B/U	

- For connector fabricating instructions, see figures 9-5 and 9-6.
- Slide conduit on cable before assembling connectors.
- Install cable clamps after fabricating cable (NAA Type 5C12, 2 required per clamp), with one-inch length of 10C2E8 under each clamp not having other conduit already installed.

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Figure No. 9-10. UHF Command Set, AN/ARC-27A, and ADF Set, AN/ARA-25 Coaxial Cables



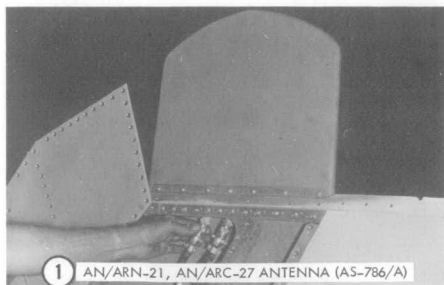


**RADIO NAVIGATION SYSTEMS****9-27. RADIO NAVIGATION SYSTEMS.**

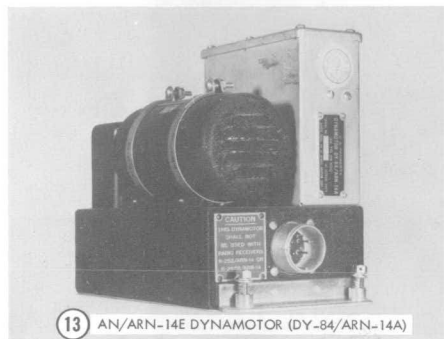
9-28. The radio navigation systems consist of a group of interrelated electronic components which the pilot uses to obtain information relative to his position, course and direction of flight. These systems terminate into

navigation instruments on the instrument panel and are controlled by the various navigation systems' control panels located on the right-hand console. The systems consist of the following components:

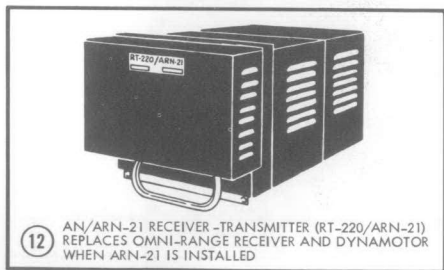
EQUIPMENT	LOCATION	FUNCTION
<b>UHF AUTOMATIC DIRECTION FINDER SET, AN/ARA-25</b>		Provides pilot with adf indications when used with uhf command set.
UHF Command Set Receiver, RT-178/ARC-27	Right-hand radio bay.	
Amplifier, AM-608/ARA-25	Top deck left-hand electrical bay.	
ADF Antenna, AS-578A/ARA-25	Bottom of fuselage center wing panel.	
Antenna Relay, RE-120/ARA-25	Top center radio bay.	
Radio Set Control, C-1703/ARC-27A	Right-hand console.	
<b>OMNI-RANGE RECEIVER, AN/ARN-14E</b>		VHF navigation aid receiver and bearing indicator.
Omni-range Receiver, R-540/ARN-14C	Right-hand radio bay.	
Dynamotor, DY-84/ARN-14, and Mount, MT-962/ARN-14	Right-hand radio bay.	
Omni-range Control Panel, C-760B/A	Right-hand console.	
Omni-range Antenna, NAA Type	On back of pilot's seat.	
Course Indicator, ID-249B/ARN	Instrument panel.	
Radio Magnetic Course Indicator, ID-250A/ARN	Instrument panel.	
Bearing Converter, ID-251/ARN	Right-hand forward radio bay.	
<b>RADIO SET, AN/ARN-21</b> (Airplanes Having Phase II of Aircraft Service Change No. 151 Complied With)		UHF navigation aid to provide bearing and range information as well as course determination when selected.
Receiver-Transmitter, RT-220/ARN-21	Right-hand radio bay.	
Mount, MT-928/ARN-21	Right-hand radio bay.	
Radio Set Control Panel, C-866/ARN-21	Right-hand console.	
Antenna, AS-786/A	Top of vertical stabilizer.	
Phase Detector, CV-279/ARN-21	Upper center radio bay.	



1 AN/ARN-21, AN/ARC-27 ANTENNA (A5-786/A)



13 AN/ARN-14E DYNAMOTOR (DY-84/ARN-14A)



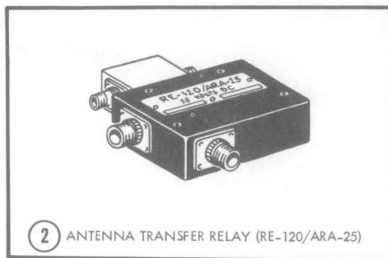
12 AN/ARN-21 RECEIVER-TRANSMITTER (RT-220/ARN-21)  
REPLACES OMNI-RANGE RECEIVER AND DYNAMOTOR  
WHEN ARN-21 IS INSTALLED



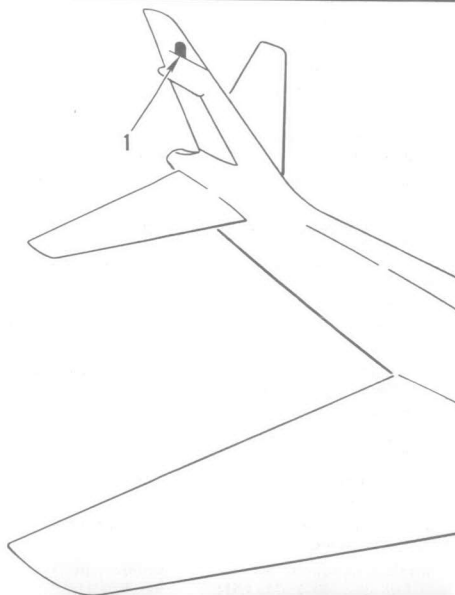
11 AZIMUTH INDICATOR (ID-307/  
ARN-21) REPLACES ID-251/ARN  
WHEN ARN-21 IS INSTALLED



10 BEARING CONVERTER  
INDICATOR (ID-251/ARN)



2 ANTENNA TRANSFER RELAY (RE-120/ARA-25)



9 ADF ANTENNA (A5-578A/ARA-25)

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Figure No. 9-11. Radio Navigation Systems Locator (Sheet 1)

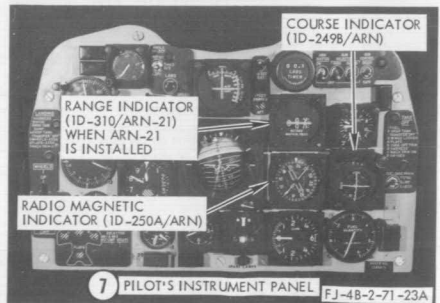
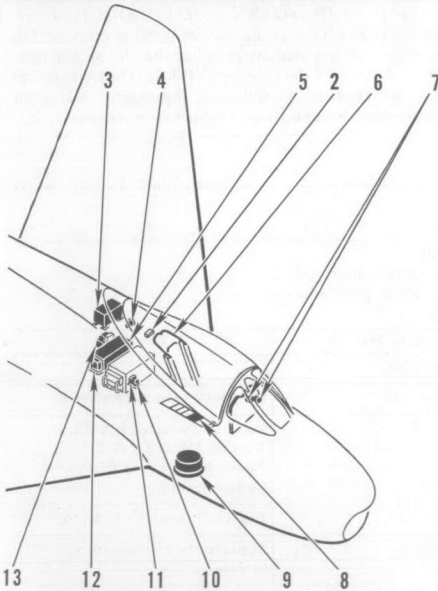
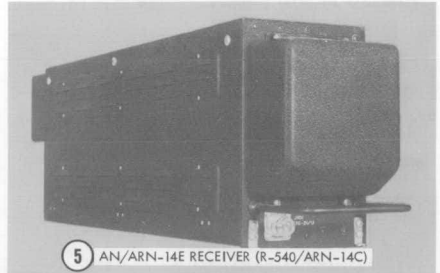
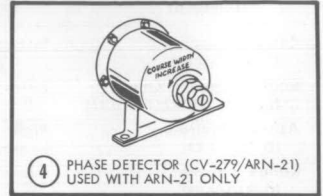


Figure No. 9-11. Radio Navigation Systems Locator (Sheet 2)

EQUIPMENT	LOCATION	FUNCTION
Course Indicator, ID-249B/ARN	Instrument panel.	
Radio Magnetic Course Indicator, ID-250A/ARN	Instrument panel.	
Azimuth Indicator, ID-307/ARN	Right-hand radio bay (replaces bearing converter, ID-251/ARN).	
Range Indicator, ID-310/ARN	Instrument panel.	
Compass Coupler (Eclipse-Pioneer) (Used as Auxiliary Equipment)	Top deck left-hand electrical bay.	

### 9-29. FUNCTION OF NAVIGATION SYSTEMS.

9-30. The radio navigation systems are interconnected with the indicators used with the polar path compass system. Bearing information from the navigation systems is compared with magnetic heading information from the compass system and converted to azimuth (course) and range information. This function is performed by the

indicators, ID-249B/ARN, ID-310/ARN (when installed) and ID-251/ARN or ID-307/ARN (when installed). The information may be received from aircraft navigational aid stations in either the vhf or uhf spectrum. Details of the functions of the navigation systems are described in the following paragraphs and in the operational handbooks applicable to the systems.

### 9-31. TROUBLE SHOOTING RADIO SET, AN/ARN-21.

**TEST EQUIPMENT:** D-C voltmeter.  
A-C voltmeter.

**SYSTEM CONDITIONS:** 28-Volt d-c power applied to airplane.  
ARN-21 and NO. 1 INV PWR circuit breakers engaged.  
INST. AC POWER switch in the "NO. 1 INV." position.  
Check that No. 2 inverter is operating.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>SYSTEM INOPERATIVE; NO VISUAL OR AURAL INDICATION.</b>			
No a-c power to receiver-transmitter, RT-220/ARN-21.	Check between test points XAL, XBA and ground.	115 volts ac.	Continue trouble shooting.
		Zero volts.	Refer to paragraph 8-78, Trouble Shooting A-C Power Supply and Distribution System.
	Check between test points RTA, RTB and ground.	115 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire(s) to fuses.
No d-c power to receiver-transmitter, RT-220/ARN-21.	Check between test point RTC and ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective d-c power wire.
No a-c single-phase power to system.	Check between test point XVA and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Refer to paragraph 8-78, Trouble Shooting A-C Power Supply and Distribution System.
No a-c single-phase power to radio magnetic indicator, ID-250A/ARN.	Check between test point RTD and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire to test point XVA.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>SYSTEM INOPERATIVE; NO VISUAL OR AURAL INDICATION. (Cont)</b>			
No a-c single-phase power to course indicator, ID-249B/ARN.	Check between test point RTE and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire to test point XVA.
No a-c single-phase power to azimuth indicator, ID-307/ARN.	Check between test point RTF and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire(s).
No a-c single-phase power phase detector, CV-279/ARN-21.	Check between test point RTH and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire(s).
No a-c single-phase power to compass coupler.	Check between test point RTG and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire(s).

**VISUAL INDICATION ALL RIGHT—NO AURAL INDICATION.**

Audio output wire is not connected properly.	Check that audio output wire from control panel is connected to test point RTJ.	None.	Reconnect wiring, as necessary.
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**BEARING INFORMATION TO COURSE INDICATOR, ID-249B/ARN, LAGS MOTION OF AIRPLANE.**

A-C power wiring to course indicator, ID-249B/ARN, is improperly connected.	Check that 26-volt a-c power wire to course indicator, ID-249B/ARN, is connected to test point RTK.	26 volts ac between test point RTE and ground.	No action.
		Less than 26 volts ac between test point RTE and ground.	Reconnect wiring, as necessary.

**D-C POWER FAILURE.**

Circuit-breaker failure.	Check between test point PGC and ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.

**9-31A. TROUBLE SHOOTING OMNI-RANGE RECEIVER, AN/ARN-14E.**

**TEST EQUIPMENT:** D-C voltmeter.  
A-C voltmeter.

**SYSTEM CONDITIONS:** 28-Volt d-c power applied to airplane.  
ARN-14 and NO. 1 INV PWR circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>SYSTEM INOPERATIVE.</b>			
No d-c power to system.	Check between test point RNA and ground.	28 volts dc.	Continue trouble shooting.
		Zero volts.	Replace defective d-c power wire.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>SYSTEM INOPERATIVE. (Cont)</b>			
No a-c single-phase power to receiver, AN/ARN-14.	Check between test point RNB and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective a-c power wire(s).
No a-c single-phase power to bearing converter indicator, ID-251/ARN.	Check between test point RNC and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire(s).
No a-c single-phase power to radio magnetic indicator, ID-250A/ARN.	Check between test point RTD and ground.	26 volts ac.	Continue trouble shooting.
		Zero volts.	Replace defective wire(s).
No a-c single-phase power to course indicator, ID-249B/ARN.	Check between test point RTE and ground.		Continue trouble shooting.
		Zero volts.	Replace defective wire(s) or defective 47-ohm resistor.

**D-C POWER FAILURE.**

Circuit-breaker failure.	Check between test point PGF and ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.

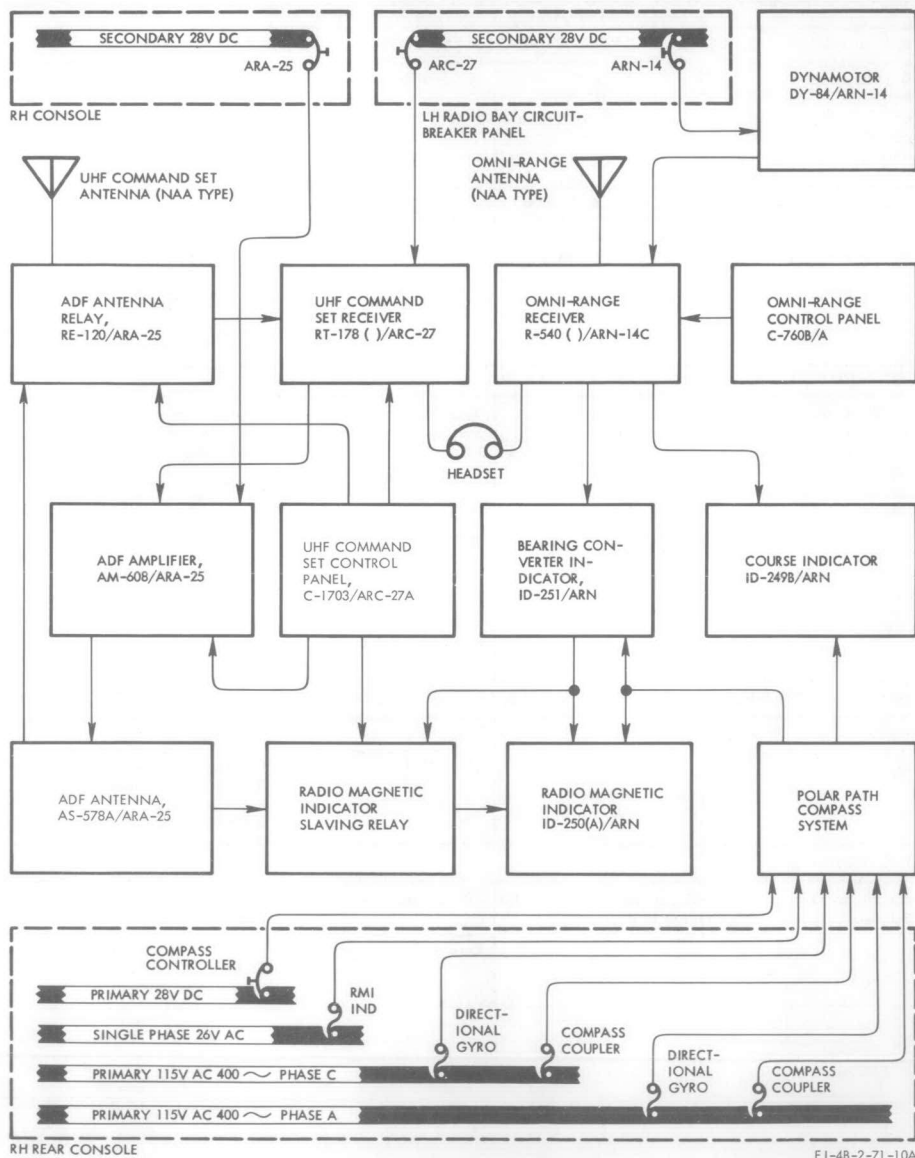
9-31B. TROUBLE SHOOTING UHF DIRECTION FINDER SET, AN/ARA-25.

**TEST EQUIPMENT:** Ohmmeter.  
D-C voltmeter.  
A-C voltmeter.

**SYSTEM CONDITIONS:** 28-Volt d-c power applied to airplane.  
NO. 1 INV PWR, ARC-27 and ARA-25 circuit breakers engaged.  
RMI fuse removed.  
ADF not selected on ARC-27 control panel.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>NO. 1 POINTER OF RADIO MAGNETIC INDICATOR, ID-250A/ARN INOPERATIVE.</b>			
Defective RMI relay or defective associated wiring.	Check between test points RCA and RTD.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective wire.
	Check between test points RCB and RCD.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective wire.
	Check between test points RCC and RCE.	Zero ohms.	Continue trouble shooting.
		Other than zero ohms.	Replace defective wire.
	<b>Note</b> Select ADF position with control switch on ARC-27 control panel. Perform two previous steps.	Infinite ohms in each step.	Continue trouble shooting.
		Zero ohms in each step.	Replace RMI relay or defective ground wire from ARC-27 control panel.

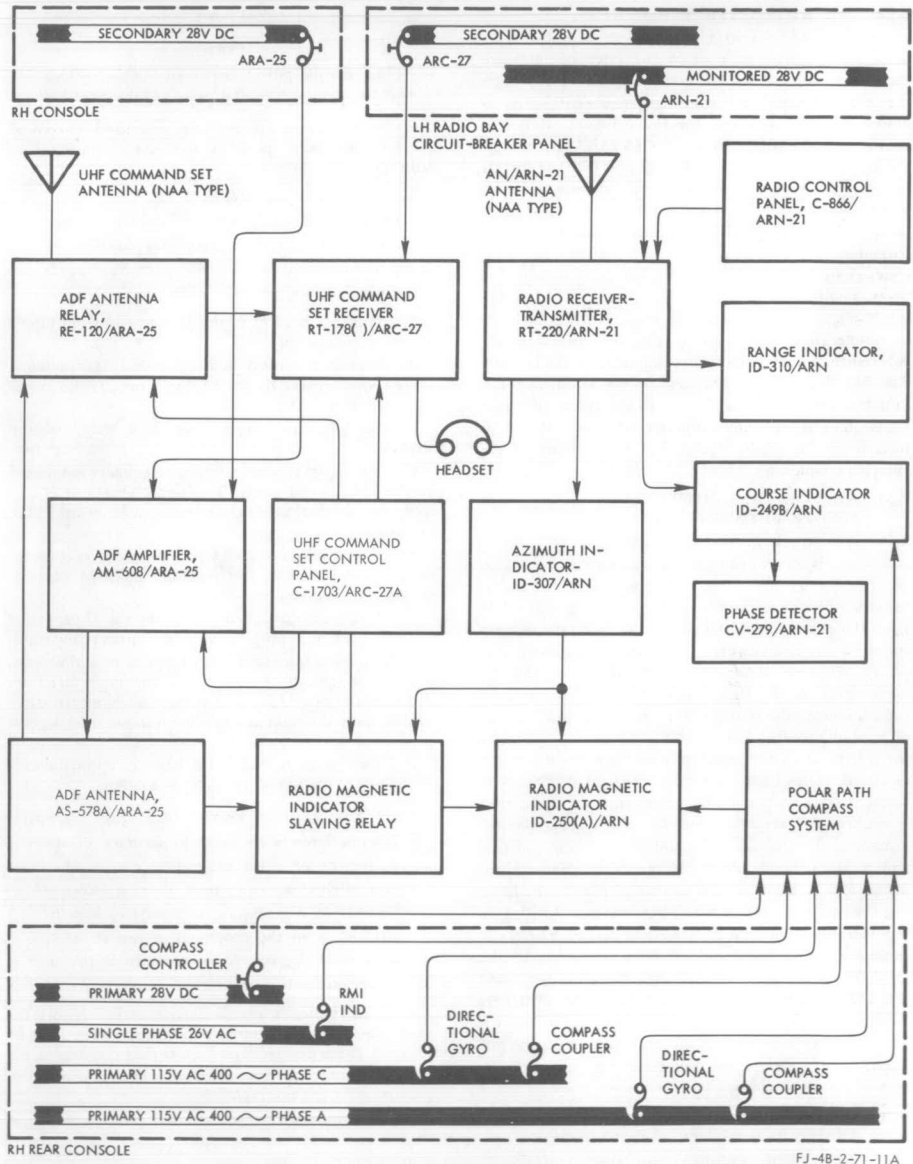
PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
NO. 1 POINTER OF RADIO MAGNETIC INDICATOR, ID-250A/ARN, INOPERATIVE. (Cont)			
Defective radio magnetic course indicator, ID-250A/ARN or defective associated wiring.	<b>Note</b> Replace RMI fuse. Check between test point RTD and ground.	26 volts ac.	Replace radio magnetic indicator.
		Zero volts.	Replace defective wire to test point XVA.
UHF DIRECTION FINDER SET WILL NOT SHIFT ANTENNAS.			
Defective antenna transfer relay, RE-120/ARA-25 or defective associated wiring.	Check between test points RCF and RCH. <b>Note</b> RCH is positive.	28 volts dc.	Replace defective antenna transfer relay, RE-120/ARA-25.
		Zero volts.	Perform wire segment continuity check to test point RCK.
NO SIGNAL TO RADIO MAGNETIC INDICATOR.			
Defective amplifier, AM-608/ARA-25, defective antenna, AS-578A/ARA-25, or defective associated wiring.	Check between test points RCG and RCJ. <b>Note</b> RCG is positive.  Check between test point RCL and ground.	28 volts dc between RCG and RCJ.	Replace amplifier, AM-608/ARA-25. (Refer to paragraph 9-39.)
		28 volts dc between RCL and ground.	Replace antenna, AS-578A/ARA-25. (Refer to paragraph 9-40.)
		Zero volts between test points RCG and RCJ.	Perform wire segment continuity check to test point RCK.
		Zero volts between test point RCL and ground.	Replace defective power wire segment.
UHF DIRECTION FINDER WILL NOT RETURN TO ARC-27 ANTENNA WHEN MIC. SWITCH IS DEPRESSED.			
Defective MIC. switch or defective transfer relay, IFF-UHF.	<b>Note</b> Depress MIC. switch.  Check between test points RCF and RCH.	Zero volts.	No action.
		28 volts dc.	Replace defective MIC. switch or defective transfer relay, IFF-UHF.
D-C POWER FAILURE.			
Circuit-breaker failure.	Check between test point PBQ and ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-60, Trouble Shooting D-C Power Distribution System.



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Figure No. 9-12. Navigation Systems Block Diagram (Omni-range Receiver, AN/ARN-14E, Installed)





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Figure No. 9-13. Navigation Systems Block Diagram (Radio Set, AN/ARN-21, Installed)

9-32. UHF AUTOMATIC DIRECTION  
FINDER SET, AN/ARA-25.

9-33. ADF signals, from which this system operates, are received by the uhf command set, AN/ARC-27A. When the uhf command set control, C-1703/ARC-27A, is placed in "ADF" position, the command set receiver is connected to the adf antenna, AS-578A/ARA-25, through the antenna relay, RE-120/ARA-25, and received signals are routed into the electronic amplifier, AM-608/ARA-25, which electronically guides the adf antenna element to the position from which it transmits correct bearing information by means of its synchro to the radio magnetic course indicator's No. 1 pointer. The received signal is heard simultaneously in the pilot's headsets. When the set is not in use, the antenna relay, RE-120/ARA-25, is de-energized and connects the uhf command set, AN/ARC-27A, to its own duplex antenna in the tail cap. The No. 1 and No. 2 pointers on the radio magnetic indicator are slaved together when the direction finder set is off. The electronic amplifier, AM-608/ARA-25, is located in the left-hand electrical bay just aft of the compass coupler.

9-34. AUTOMATIC DIRECTION  
FINDER SET CONTROLS.

9-35. All power to the automatic direction finding equipment is controlled from the uhf command set radio control, C-1703/ARC-27A. No separate control panel is provided for the adf equipment. However, the B+ line from the uhf command set and the +28-volt d-c line are fused on the front panel of the electronic control amplifier. Whenever the command set is operating, the filament circuit to the electronic control amplifier is completed. Placing the four-position function switch, located on the radio control, C-1703/ARC-27A, to "ADF" connects the command set to the adf antenna, provides B+ to the electronic control amplifier tubes, connects +28 volts dc to the 100 cycles per second power vibrator of the electronic control amplifier and the antenna servomotor armature, changes the command set avc time constant and removes the avc delay voltage. A damping control is provided on the electronic control amplifier for adjusting the damping voltage which prevents overshooting of the adf antenna assembly. A volume control (GAIN) is provided on the electronic control amplifier to set the level of the audio signal delivered from the command set, thereby determining the output of the electronic control amplifier. Operating the CHAN selector switch and the three concentric frequency controls on the uhf control panel determines the frequency at which the equipment is operating.

9-36. OPERATIONAL CHECK OF AUTOMATIC  
DIRECTION FINDER SET, AN/ARA-25.

9-37. To perform an operational check, proceed as follows:

- a. Connect an external power source to airplane.

**Note**

Place the d-c power switch in "OFF" position while applying external power to the airplane.

- b. Place function switch on uhf command set control panel to the "ADF" position and allow equipment to warm up for 5 minutes.

**Note**

Do not turn equipment off and on rapidly. High starting current used may damage the power relay contacts if contacts are drawn apart during starting period.

- c. Connect a headset to the jack provided on pilot's oxygen tube assembly.

- d. Connect a vertical quarter wave length antenna (antenna, AT-141/AR, can be used) to a TS-497/URR signal generator.

- e. Place the antenna 50 feet dead ahead of the airplane.

- f. Tune signal generator to same frequency as selected on the uhf control panel. The signal generator is correctly tuned when a 100-cycle buzz can be heard in the headset.

- g. Check reading of No. 1 pointer on the radio magnetic course indicator. The reading should be approximately zero degrees.

- h. Disconnect the antenna from the signal generator and move antenna approximately 30 degrees to the right.

- i. Reconnect antenna to signal generator and observe response of indicator needle to this change in direction. The indicator needle should have traveled approximately 30 degrees to the right at a minimum speed of 30 degrees per second.

- j. Repeat steps h. and i. for heading approximately 30 degrees to the left of the airplane heading.

**Note**

Do not attempt to estimate accuracy of the equipment or make calibration curves when ground checking equipment. Bearing errors as great as 15 degrees can be expected when the airplane is on the ground, whereas, errors as high as 20 degrees can be expected in the air except on relative bearings of  $\pm 5$  degrees.

- k. If the indicator needle movement is sluggish, the GAIN control on the electronic control amplifier must be adjusted. If the needle "hunts" more than one degree, the DAMPING control requires adjusting. For adjustment procedures, refer to paragraph 9-38.

- l. Place function switch on uhf control panel to "OFF."

- m. Remove headset.

- n. Remove external power from the airplane.

9-38. ADJUSTING ELECTRONIC CONTROL AMPLIFIER GAIN AND DAMPING CONTROLS. To adjust the GAIN and DAMPING controls, proceed as follows:

**Note**

These controls should be adjusted only after an operational check has indicated the need for adjustment.

- a. Connect an external power source to airplane.

**Note**

Place d-c power switch in "OFF" position while applying external power to the airplane.

- b. Engage ARC-27 and ARA-25 circuit breakers. Place the function switch on the uhf control panel to "ADF" and allow a 5-minute warm-up period.

c. If adjustment of GAIN control is necessary, turn the locking nut counterclockwise and advance GAIN control until a minimum needle movement speed of 30 degrees per second is reached.

d. If adjustment of DAMPING control is necessary, turn locking nut counterclockwise and advance DAMPING control until the needle "hunting" is reduced to less than one degree.

**Note**

Do not advance DAMPING control beyond three-fourths of its maximum range. If necessary, reduce the gain of the amplifier until DAMPING control is effective without exceeding this limit.

- e. Lock the GAIN and DAMPING controls by turning the locking nuts clockwise.

f. Place function switch on uhf control panel to "OFF," remove the external power source and pull ARC-27 and ARA-25 circuit breakers.

9-38A. FJ AIRCRAFT SERVICE CHANGE NO. 151 INFORMATION. Aircraft Service Change No. 151 is divided into four phases. The phases are as follows:

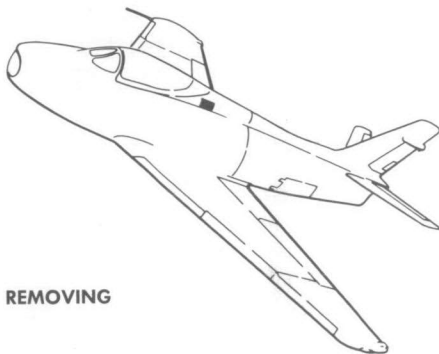
a. Phase I, accomplished by contractor prior to delivery, installs provisions for accommodating AN/ARN-21 equipment while retaining AN/ARN-14E equipment and provisions.

b. Phase II removes AN/ARN-14E equipment and installs AN/ARN-21 equipment.

c. Phase III removes AN/ARN-14E wiring and provisions.

d. Phase IV replaces the 1500 volt-ampere inverter with a 2500 volt-ampere inverter to supply the increased current requirements of the AN/ARN-21 equipment. (Refer to paragraph 8-80.)

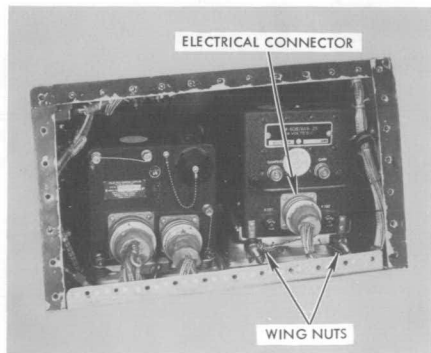
9-39. REMOVING AND INSTALLING ELECTRONIC CONTROL AMPLIFIER, AM-608/ARA-25.



**REMOVING**

**Caution** Make certain no electrical power is applied to system.

- 1 Locate and remove electrical radio access panel on left-hand side of fuselage near aft end of canopy.



- 2 Locate amplifier on shelf just aft of compass coupler and remove safety wire from electrical connector and wing nuts.

- 3 Remove electrical connector and stow.

- 4 Loosen wing nuts until retainer cups disengage from feet on amplifier.

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- 5** Lift front end of amplifier by handle and pull out-board to remove from mount.



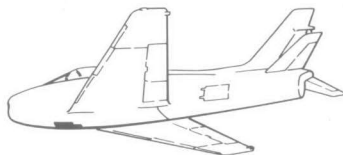
## INSTALLING

**Caution** Make certain no electrical power is applied to system.

- 1** Lift amplifier onto shelf and slide inboard until lip on rear of amplifier engages with slot on mount.
- 2** Engage retainer cups on mount screws with feet on amplifier and tighten wing nuts to secure.
- 3** Install electrical connector and tighten connector finger-tight.
- 4** Install AN995F32 safety wire on wing nuts and electrical connector.
- 5** Install electrical radio access cover and perform operational check of uhf automatic direction finder system. (Refer to paragraph 9-36.)

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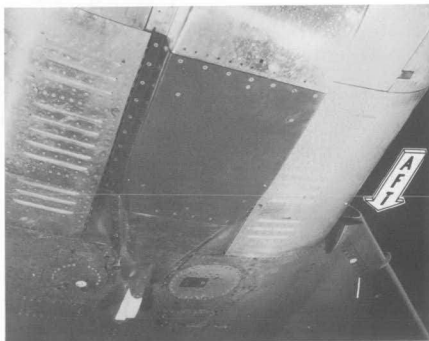
## 9-40. REMOVING AND INSTALLING ADF ANTENNA, AS-578A/ARA-25.



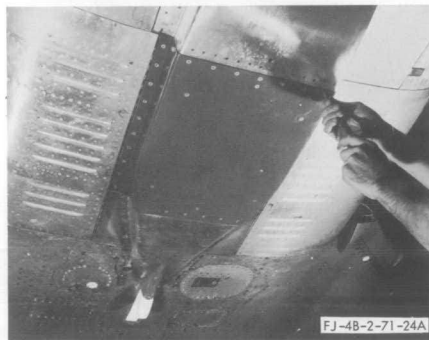
## REMOVING

**Note** Due to the location of the antenna, it is recommended that two men remove and install the antenna.

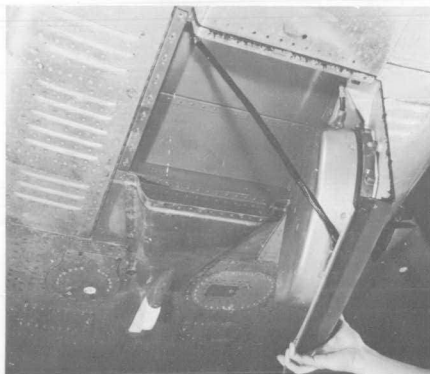
- 1** Make certain that there is no electrical power applied to the airplane.



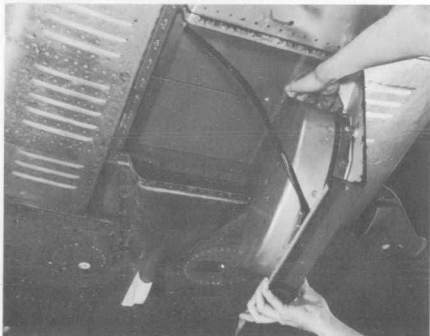
- 2** Remove thirty-seven Phillips head screws from edges of antenna and support the antenna until coaxial cable and electrical cable are disconnected.



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**3** Remove coaxial connector.



**4** Remove safety wire from electrical connector and remove connector, allowing antenna to be separated from the airplane.

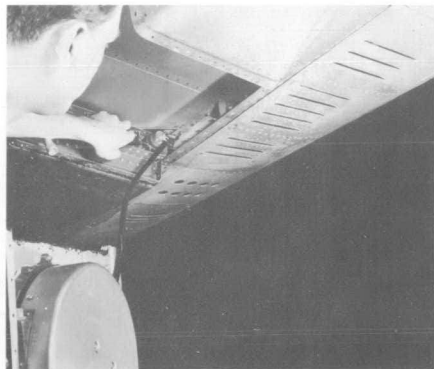


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## INSTALLING

- 1** Lift antenna into position just below airplane and install electrical connector on airplane receptacle. Safety with AN995F32 lockwire.

**Caution** Always support the antenna high enough to leave slack in cables while installing them. Damage to cables will occur if the antenna's weight hangs on them.



- 2** Carefully mate coaxial connector and receptacle and tighten finger-tight.

**Note** Installation of the coaxial cable may be accomplished by loosening the cable clamp in the nose wheel well and pulling sufficient slack through the nose wheel well bulkhead. The bulkhead grommet, forward of the antenna, may be pulled out of its mounting hole by this operation. Should this happen, reinstall the grommet from the wheel well side of the bulkhead after the coaxial cable has been installed.

- 3** Lift antenna to its installed position and install mounting screws.

**Caution** Do not tighten any mounting screws until all screws are installed. Tighten all screws a little at a time so that the antenna mounting flange will be drawn into position without bending. The material used for the antenna cover is brittle and may break when bent.

- 4** Apply ample quantity of sealant (item 108, materials list) to the antenna mounting flange.
- 5** Clean excess sealant from the antenna mounting flange if necessary.

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channels spaced 100 kilocycles apart. The frequency is selected on the control panel which operates an autopositioner mechanism on the front of the receiver. The autopositioner "sets up" the selected frequency on the receiver. Navigation information is displayed on three indicators: the course indicator, ID-249B/ARN, the radio magnetic course indicator, ID-250A/ARN, and the bearing converter, ID-251/ARN. The first two of these indicators are mounted on the instrument panel and the other indicator is mounted in the forward, lower right-hand corner of the radio equipment compartment. The course indicator consists of a vertical bar which moves laterally to give lateral guidance and a horizontal bar which moves vertically to give vertical guidance. The vertical bar is operated by the receiver and the horizontal bar is not utilized on this airplane. The two bars remain parallel to their rest positions and are always at right angles to each other. Two flag alarms labeled "OFF" come into view at one end of each bar whenever signal levels decrease to the extent that the indication of the associated bar is unreliable. A COURSE window indicates the course that is selected and a TO-FROM window shows whether the course is to or from the omni-range station. The course is set into the COURSE window with the SET control. A relative heading indicator, consisting of a pointer with a white circle on the end, moves around the inside edge of the instrument to indicate the angle between the heading of the airplane and the course set into the COURSE window. Its travel is calibrated to 45 degrees each side of center, top and bottom, to aid in approaching the desired track at definite angles and in reading wind correction angles. The radio magnetic course indicator consists of a circular scale, calibrated to 360 degrees in 2-degree increments, a fixed index, a double-barred pointer (2) and a single-barred pointer (1). The circular scale rotates in the face of the instrument and indicates the magnetic heading of the airplane on the scale underneath the fixed index at the top of the instrument. The double-barred pointer is connected to the omni-range equipment and indicates the magnetic bearing to the omni-range station on the circular scale. The single-barred pointer is connected to the automatic direction finding equipment and indicates the bearing to the uhf signal received. When "ADF" is not selected, the single-barred pointer (1) is slaved to the double-barred pointer (2). The bearing converter indicator indicates the magnetic bearing of the omni-range station on a rotating circular scale. However, the primary function of

this equipment is to mix compass and omni-range information which, in turn, is indicated by the double-barred pointer on the radio magnetic course indicator. See figure 9-14 for schematic and figure 9-12 for block diagram.

#### 9-46. OMNI-RANGE RECEIVER CONTROLS.

9-47. Operational controls for the omni-range radio equipment, located on the course indicator and the control panel, consist of the following:

NAME OF CONTROL	FUNCTION
<b>CONTROL PANEL, C-760B/A</b>	
<b>FREQ.</b>	Indicates frequency selected by two concentric knobs on the face of the panel.
<b>ON - OFF</b>	Primary power control switch.
<b>VOLUME</b>	Volume control to set level of audio output from receiver.
<b>COURSE INDICATOR, ID-249B/ARN</b>	
<b>TO - FROM</b>	Indicates whether the selected course of the airplane is to or from the received omni-range station.
<b>SET</b>	Knob control used to set the course to the omni-range station into the window at top of indicator.
<b>"OFF" flag</b>	Indicates that received signal is too weak to be reliable.

#### 9-48. OPERATIONAL CHECK OF OMNI-RANGE RECEIVER SET, AN/ARN-14E.

9-49. To perform an operational check, proceed as follows:

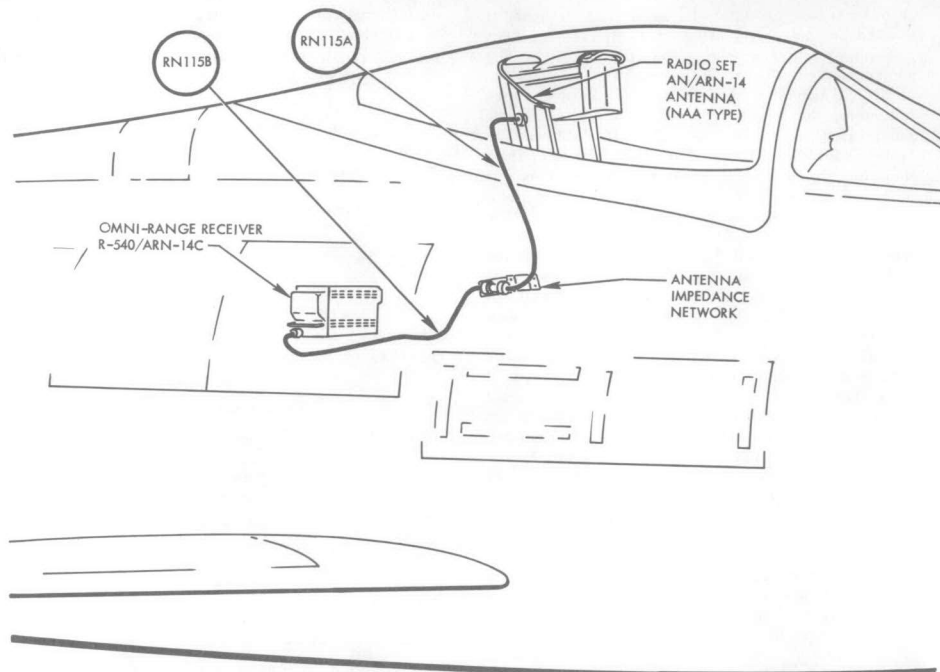
- a. Connect an external power source to airplane.

#### Note

Place d-c power switch in "OFF" position while external power is applied to the airplane.

- b. Make certain the polar path compass system is operating properly.

- c. Engage ARN-14 circuit breaker, throw power switch on omni-range control panel to "ON" and allow a 3-minute warm-up period.



CABLE DETAILS

CABLE NUMBER	IDENT	FORWARD CLAMP	CONNECTOR TYPE (FORWARD)	CABLE TYPE	CUT CABLE LENGTH	CONDUIT	CONNECTOR TYPE (AFT)	AFT CLAMP
RN115A	DUPLICATE ORIGINAL		UG-21B/U	RG8A/U	32-1/4 IN.		UG-21B/U	
RN115B	DUPLICATE ORIGINAL	5C12	UG-21B/U	RG83/U	50-1/4 IN.	10C-2E9-1 (FWD & AFT)	UG-21B/U	5C12

- For connector fabricating instructions, see figures 9-5 and 9-6.
- Slide conduit on cable before assembling connectors.
- Install cable clamps after fabricating cable (NAA type 5C12 two required per clamp) with one-inch length of 10C2E9 under each clamp not having other conduit already installed.

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Figure No. 9-15. Omni-range Set, AN/ARN-14E, Coaxial Cables



**Note**

Place airplane within line of sight of local omni-range transmitter, otherwise erratic reception may result.

d. Set frequency of local vhf transmitter into vertical window of control panel. Frequency setup time of the autotune mechanism should not exceed 6 seconds.

e. Identify station from coded signal in headset or from tower traffic. Note if signal level is adequate and if volume control (VOL) is effective.

f. Set frequency of local VOR station into vertical window of control panel. The magnetic bearing to the VOR station should be indicated by the No. 2 pointer of the radio magnetic course indicator.

g. Rotate SET knob on the course indicator until the bearing indicated on the No. 2 pointer on the radio magnetic course indicator appears in the course indicator window. The vertical bar on the course indicator should be centered.

h. The TO-FROM indicator will read "TO" when the VOR station is within the bearing range indicated in the course set window (approximately  $\pm 90$  degrees, with the scale calibrated to  $\pm 45$  degrees). Inversely, the TO-FROM indicator will read "FROM" when the station bearing is more than 90 degrees from the set course range.

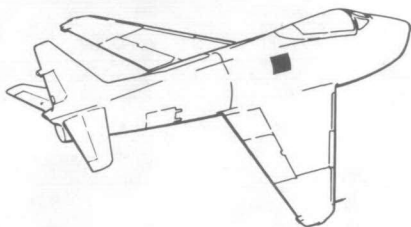
i. Check readings on radio magnetic course indicator, bearing converter and course indicator. Pointer readings should agree within 3 degrees, except in areas where large radiating surfaces are adjacent to the airplane.

j. Disengage ARN-14 circuit breaker and turn off gyro compass system.

**Note**

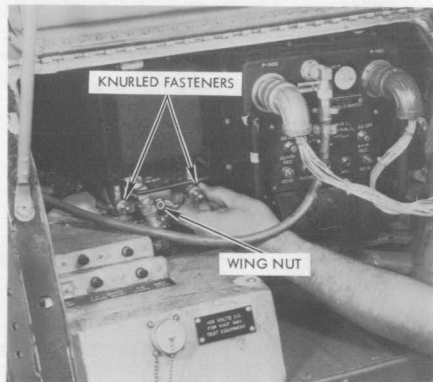
It is not abnormal for the No. 2 pointer of the radio magnetic course indicator, ID-250A/ARN, to rotate as though searching when receiver set, AN/ARN-14E, is turned off.

## 9-50. REMOVING AND INSTALLING OMNI-RANGE RECEIVER, R-540/ARN-14C.

**REMOVING**

**Caution** Make certain that no power is applied to system.

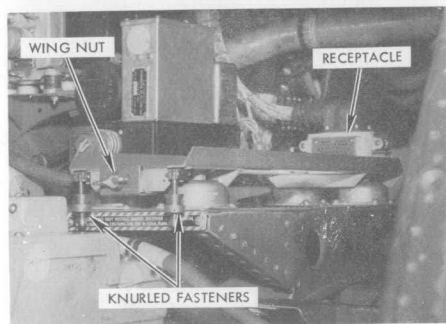
- 1** Open and support right-hand radio bay access door.
- 2** Loosen two knurled fasteners from lower face of unit until they disengage from feet on receiver.
- 3** Disconnect coaxial cable connector from face of unit.



- 4** Loosen wing nut fastener on lower center face of unit.
- 5** Disconnect coaxial lead from uhf command set receiver-transmitter, RT-178/ARC-27.

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- 6** Pull unit directly outboard to disengage pins at the rear of unit, and remove from radio bay.



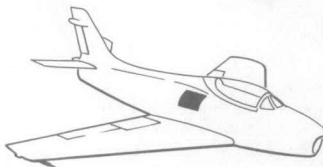
## INSTALLING

**Caution** Make certain that no power is applied to system.

- 1** Place unit on mount and slide inboard into position making certain that pins at the rear of unit are aligned with receptacle.
- 2** Tighten wing nut on lower center face of unit until pins at rear of unit are fully seated.
- 3** Engage two knurled fasteners at lower corners of face of unit and tighten fasteners.
- 4** Safety-wire knurled fasteners and wing nut with AN995F32 wire.
- 5** Connect coaxial cable connector to face of unit and safety-wire with AN995F32 wire.
- 6** Reconnect and safety coaxial lead to uhf command set receiver-transmitter, RT-178/ARC-27, with AN995F32 safety wire.
- 7** Perform operational check of omni-range set, AN/ARN-14E.

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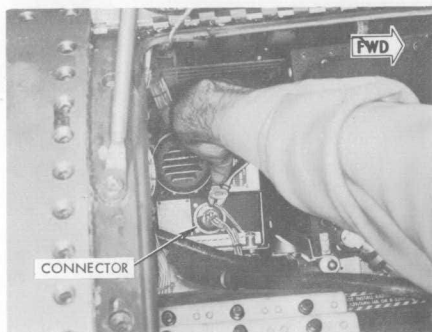
## 9-51. REMOVING AND INSTALLING DYNAMOTOR, DY-84/ARN-14.



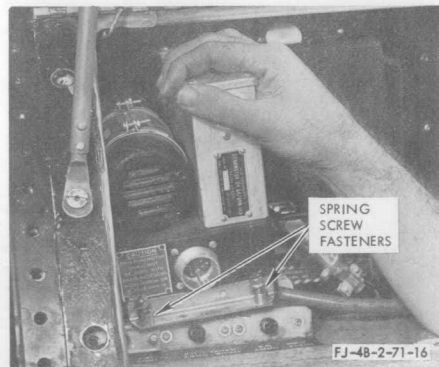
### REMOVING

**Caution** Make certain no electrical power is applied to system.

- 1** Disconnect electrical connector on face of unit.



- 2** Disconnect two spring screw fasteners at face of unit and lift front of dynamotor up and outboard to remove.



## 9-52. REMOVING AND INSTALLING OMNI-RANGE ANTENNA, NAA TYPE.

## REMOVING

*Caution* Make certain that external power is removed from the airplane.

- 1 Remove canopy. (Refer to paragraph 2-31.)
- 2 Remove butterfly clamps from coaxial cable fittings. Remove coaxial connector from base.



## INSTALLING

*Caution* Make certain no electrical power is applied to system.

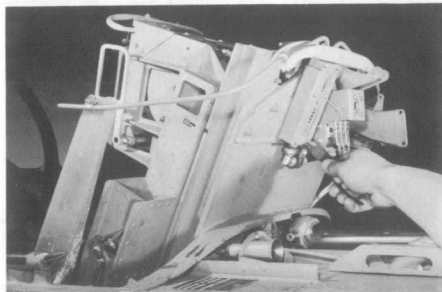
- 1 Position unit on mount and slide fully inboard.
- 2 Secure two spring screw fasteners on face of unit.
- 3 Connect electrical connector to face of unit.
- 4 Safety electrical connector and spring screw fasteners with AN995F32 wire.
- 5 Perform an operational check of omni-range set. (Refer to paragraph 9-48.)

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- 3 Cut safety wire from fillister head screws on base of antenna.

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- 4** Loosen clamps on end of antenna elements.
- 5** Remove six fillister head screws from base of antenna and lift antenna and base from airplane.



**Note** If a faulty antenna is suspected, the antenna base may be further disassembled to allow the lead-in jumpers and capacitor to be inspected.

**Note** If the antenna coaxial cable is to be left disengaged from the antenna for some time, the coaxial cable must be covered to provide protection against entry of moisture and foreign material.

## INSTALLING

- 1** Slide antenna base down inside of channel and secure with six fillister head screws. Safety screws with AN995F32 wire.
- 2** Install coaxial connector on bottom of base and tighten finger-tight.
- 3** Install butterfly clamps to secure coaxial cable to base receptacle.
- 4** Install clamp on end of each element.
- 5** Perform operational check of omni-range receiver. (Refer to paragraph 9-48.)

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### 9-53. RADIO SET, AN/ARN-21—AIRPLANES HAVING SERVICE CHANGE NO. 151 COMPLIED WITH.

9-54. Radio set, AN/ARN-21, is designed to operate in conjunction with the surface (ground or shipboard) navigation beacon, AN/URN-3. The two associated equipments form a radio navigation system which enables the pilot to obtain continuous indications of his distance and bearing from any selected surface beacon located within a line-of-sight distance from his airplane up to 195 nautical miles. The bearing information and the distance information are displayed on two separate indicators known as the azimuth indicator, ID-307/ARN, and the range indicator, ID-310/ARN.

### 9-55. FUNCTION OF RADIO SET, AN/ARN-21.

9-56. The interoperation of the radio set, AN/ARN-21, and the surface navigation beacon, AN/URN-3, is on the interrogator-responder principle. The radio set transmitter, part of the receiver-transmitter, RT-220/ARN-21, initiates the interrogation process by radiating pulse signals. These signals, known as distance interrogation pulses, are detected at the particular receiver of the land- or ship-based navigation beacon, AN/URN-3, to which the pilot has tuned his equipment. These pulses, in turn, "trigger" the beacon causing it to respond with its own transmitting pulses. The beacon response pulses are received by the receiver portion of the receiver-transmitter, RT-220/ARN-21. Special range circuits measure the elapsed time between transmission of the interrogation pulse and the reception of the response signal. Other circuits convert the time difference into a distance indication which is displayed on the range indicator, ID-310/ARN. Besides the response pulse, the navigation beacon, AN/URN-3, transmits a continuous reference signal consisting of a series of radio frequency pulses. These signals can be received by the receiver portion of the receiver-transmitter at any time the receiver portion is in operation. This pulse information is displayed as a bearing indication on the azimuth indicator, ID-307/ARN, which is not visible to the pilot, and interpreted by the course indicator, ID-249B/ARN, and radio magnetic indicator, ID-250A/ARN. Bearing information may be received even though interrogation pulses are not being transmitted. Under favorable conditions of reception, bearing information from beacons beyond the 195-mile limit of the range indicator is displayed on the azimuth indicator. Whenever bearing signals alone, or both bearing and range signals, are being received, a three letter tone identification signal in Morse code is also received. The transmitter section of the receiver-transmitter, RT-220/ARN-21, transmits pulse signals in the frequency range of 1025 to 1150 megacycles. The receiver section operates in the frequency ranges of 962 to 1024 megacycles and 1151 to 1213 megacycles. There are 126 frequency channels, any one of which can be selected by setting the proper controls on the control panel, C-866/ARN-21. The equipment is designed so that, when correct bearing and distance information



9-45

cannot be determined, the indicators will "search" by rotating rapidly and will prevent the pilot from deriving improper information from the indicators. Also, a red line extends across the window of the range indicator when the information is unreliable and the indicator is "searching." See figure 9-16 for schematic and figure 9-13 for block diagram.

9-57. RADIO SET RECEIVER-TRANSMITTER,  
RT-220/ARN-21.

9-58. The receiver-transmitter, RT-220/ARN-21, is located in the right-hand radio bay and contains circuitry which interprets details of received beacon signals so that resultant information can be placed on the system's indicators. Channel selection is accomplished in the receiver and transmitter by means of a crystal turret, rotated by a reversible electric motor that receives its power from an electromechanical servo system. Actual channel selection, as performed on the radio set control panel, C-866/ARN-21, sets the tuning servo system into operation. Receiver output is roughly divided into range circuits, azimuth circuits and tone circuits. Range circuits terminate in the range indicator, ID-310/ARN, azimuth circuits terminate in the azimuth indicator, ID-307/ARN, and tone circuits are connected to the pilot's headsets. The transmitter is modulated by video-type pulses which are generated in the receiver-transmitter unit. Peak power output of the transmitter is approximately one kilowatt. Transmission and reception both are on the tail cap antenna, AS-786/A. See figure 9-16 for schematic of system interconnections.

9-59. RADIO SET, AN/ARN-21, CONTROLS.

9-60. All air-borne operating controls for the radio set, AN/ARN-21, are located on the radio set control panel, C-866/ARN-21. The controls and their functions are as follows:

NAME OF CONTROL	FUNCTION
RADIO SET CONTROL PANEL, C-866/ARN-21	
OFF-REC-T/R	Power control switch. Positions are as follows:
OFF	Set turned off.
REC	Receiver only operates to provide bearing information.
T/R	Receiver and transmitter operating. Bearing and range indications received.
CHAN	Selector used to choose the desired beacon channel. Knobs which can be selected are as follows: Left-hand knob indicates in digits of tens and hundreds. Right-hand knob indicates in units.
VOL	Adjusts volume level of audio identification signal.

Combinations of dial channels may be selected from 00 to 129. However, the equipment operates only on channels 01 to 126.

**CAUTION**

No attempt should be made, at any time, to set the CHAN dial below channel 01 or above 126. Channels outside of this range are for bench testing only.

9-61. PREFLIGHT CHECKS AND ADJUSTMENTS  
OF RADIO SET, AN/ARN-21.

**Note**

Place d-c power switch in "OFF" position while applying external power to the airplane.

a. Engage ARN-21 circuit breaker and set the CHAN selector on the control panel to a channel other than the one chosen for the check. Set the VOL control halfway between its extreme "cw" and "ccw" setting.

**Note**

The polar path compass system must be operating for these checks.

b. Set the OFF-REC-T/R switch to "REC." Allow a warm-up period of 90 seconds. At the end of that period, the bearing indicator, ID-307/ARN, should begin spinning.

c. Turn the CHAN selector to the channel of the local navigation beacon, AN/URN-3. The pointer on the azimuth indicator, ID-307/ARN, should stop in a position which indicates the location of the beacon relative to the airplane.

d. If there is a deviation between the indicator reading and the predetermined bearing of the beacon, the AZIMUTH ZERO SET screwdriver control may need adjusting for the proper bearing indication on the azimuth indicator. However, it should first be determined that such error is not due to local siting or reflection effects.

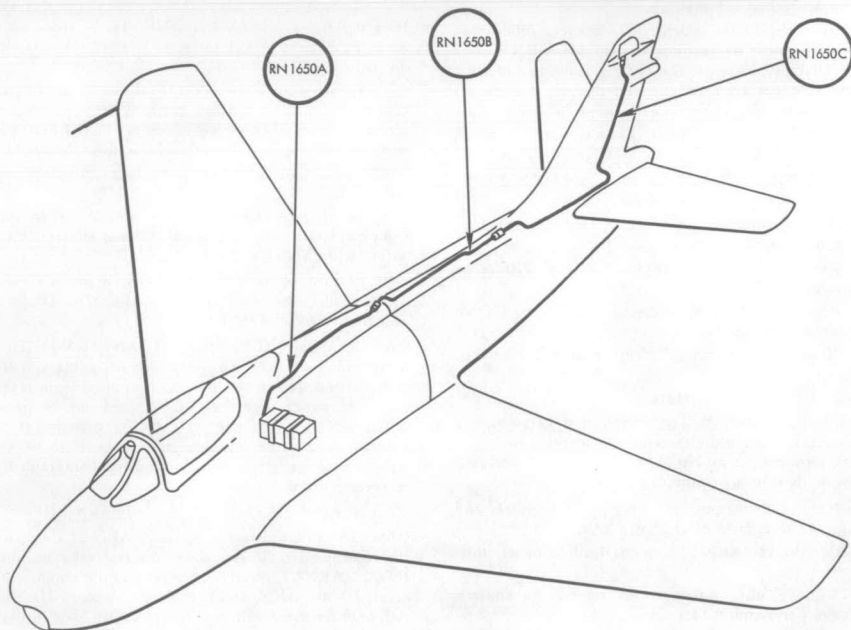
**Note**

The AZIMUTH ZERO SET and RANGE ZERO SET screwdriver controls are located on the bottom of the receiver-transmitter front panel.

e. Place the OFF-REC-T/R switch to "T/R." After a short period of searching, the flag on the distance indicator dial, ID-310/ARN, should move up behind the meter face to display the distance between the airplane and the local beacon. The bearing indication on the azimuth indicator should not change.

f. If the deviation between the range indicator reading and the predetermined distance of the beacon is incorrect, adjust the RANGE ZERO SET control for the correct distance indication.

g. Plug a headset into the headset jack. A tone identification signal should be heard. Adjust the VOL control



CABLE DETAILS

CABLE NUMBER	IDENT	FORWARD CLAMP	CONNECTOR TYPE (FORWARD)	CABLE TYPE	CUT CABLE LENGTH	CONDUIT	CONNECTOR TYPE (AFT)	AFT CLAMP
RN1650A	DUPLICATE ORIGINAL	5C12	UG-59B/U	RG-87A/U	91 IN.	8C7B8-21	DIC-2529	5C12
RN1650B	DUPLICATE ORIGINAL	5C12	DIC-2533	RG-87A/U	104 IN.	10C2E9-18	DIC-2529	5C12
RN1650C	DUPLICATE ORIGINAL	5C12	DIC-2533	RG-98/U	148-1/2 IN.	8C7B8-32 AFT	DIC-2533	5C12

- For connector fabricating instructions, see figures 9-5 and 9-6.
- Slide conduit on cable before assembling connectors.
- Install cable clamps after fabricating cable (NAA type 5C12 two required per clamp) with one-inch length of 10C2E9 conduit under each clamp not having other conduit already installed.

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Figure No. 9-17. Radio Set, AN/ARN-21, Coaxial Cables



for the desired signal strength.

h. Turn the CHAN selector to a channel other than that of the local navigation beacon, AN/URN-3. The tone signal should cease, the bearing azimuth indicator pointer should start searching and the red flag should come up over the numbers on the range indicator.

i. Shut down equipment by placing function switch to "OFF," and disengaging ARN-21 circuit breaker.

9-62. INSTALLING RADIO SET, AN/ARN-21. To install radio set, proceed as follows:

a. Remove omni-range receiver, R-540/ARN-14C. (Refer to paragraph 9-50.)

b. Remove dynamotor, DY-84/ARN-14. (Refer to paragraph 9-51.)

c. Remove AN/ARN-21 electrical connectors from their storage receptacles.

d. Remove omni-range receiver and dynamotor mounts.

#### Note

When removing the receiver and dynamotor mounts, remove the receiver wire harness back to terminal strips No. 135, 136 and 137 and stow dynamotor connector.

e. Remove dynamotor mount support channels and the storage receptacle bracket as a unit.

f. Detach AN/ARN-21 antenna lead from its stowage.

g. Remove uhf command set receiver-transmitter. (Refer to paragraph 9-14.)

h. Loosen omni-range antenna cable clamps and push cable under the uhf command set receiver-transmitter mount. Clamp end of cable securely.

i. Loosen dynamotor wiring clamps and stow dynamotor plug on dummy storage receptacle provided.

j. Install a right angle adapter, UG-212A/U, on the end of the AN/ARN-21 antenna cable.

k. Install radio receiver-transmitter mount, MT-928/ARN-21.

l. Install electrical connectors on mount.

m. Position receiver-transmitter on mount and push inboard until fully seated.

n. Tighten and safety-wire wing nuts.

o. Connect antenna cable to front of receiver-transmitter.

p. Disconnect wiring from bearing converter, ID-251/ARN, and remove indicator.

q. Detach wiring for azimuth indicator, ID-307/ARN, from stowage receptacle.

r. Stow wiring for bearing converter, ID-251/ARN, on its stowage receptacle.

s. Install azimuth indicator, ID-307/ARN, and connect wiring. The azimuth indicator must be front-mounted.

t. Install uhf command set receiver-transmitter. (Refer to paragraph 9-14.)

u. Remove cover plate labeled "PROVISIONS FOR ID-310/ARN-21 RANGE INDICATOR" from instrument panel and install range indicator, ID-310/ARN, on panel.

v. Rotate stud fasteners on front of instrument panel counterclockwise and allow instrument panel to come aft to position where safety cords are taut. Install presently stowed connector on range indicator, ID-310/ARN.

w. Reposition instrument panel to its normal position and secure.

x. Install phase detector, CV-279/ARN-21, in upper right-hand radio bay and install stowed electrical cable. Safety with AN995F32 wire.

y. Perform operational check of radio set, AN/ARN-21, and uhf command set, AN/ARC-27A. (Refer to paragraphs 9-9 and 9-61.)

9-63. REMOVING RADIO SET, AN/ARN-21. To remove radio set, AN/ARN-21, refer to paragraph 9-62 and perform steps f. through x., as applicable, in reverse order. However, electrical cables need not be permanently stored unless the set is being permanently removed. In case the omni-range receiver is to be reinstalled, perform steps a. through e. of paragraph 9-62 in reverse order.

9-64. PHASE DETECTOR, CV-279/ARN-21.

9-65. The phase detector, CV-279/ARN-21, located in the right-hand radio bay above the receiver-transmitter, RT-220/ARN-21, receives signals from the azimuth indicator, ID-307/ARN, and the course indicator, ID-249B/ARN. From these voltages, the phase detector produces control signals to operate the vertical bar and the "TO-FROM" flag on the course indicator, ID-249B/ARN.

9-66. RADIO NAV TEST RECEPTACLE.

9-67. A receptacle is provided to supply 28 volts dc to operate vhf navigation test equipment. (See figure 9-18.) This receptacle is located on the right-hand radio bay junction box and is powered by the primary bus through the RADIO NAV TEST circuit breaker. The receptacle is capped to exclude dirt and other foreign objects.

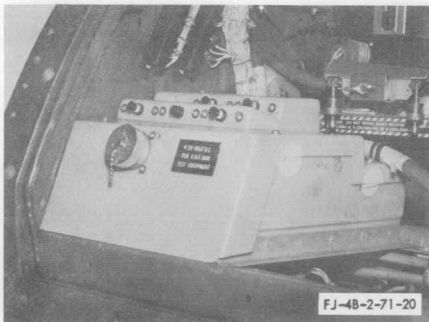


Figure No. 9-18. Radio Nav Test Receptacle



## RADAR EQUIPMENT

## 9-68. RADAR EQUIPMENT.

9-69. The radar equipment complement consists of the radar identification set, AN/APX-6B, and provisions for installing the radar set, AN/APG-30A. For information concerning the radar identification set, AN/APX-6B, and its associated components, refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A). Space provided for the radar set, AN/APG-30A, is alternately utilized by the LABS equipment. [Refer to the Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A).] Radar set, AN/APG-30A (figures 9-19 and 9-20), when installed, supplies information to the aircraft fire control system and is the radar equipment associated with the armament control system. All radar equipment except the antennas and the pilot's cockpit controls is located in the upper nose section of the airplane and is accessible when the nose equipment bay cover is removed. (See figure 9-19.)

9-70. RADAR SET, AN/APG-30A.

9-71. The radar set, AN/APG-30A, is designed for use in daytime air-to-air tactical operations. The radar performs the functions of automatic search in range and tracking in range. It delivers the range information to the aircraft fire control system after the antenna has been trained on the target. Since the relationship between the guns and the radar antenna is fixed, radar range information will be immediately available when the target is framed and the radar is locked on the target. Delivery of range information to the computers, Mark 86 Mod 0 and Mark 87 Mod 0, in the aircraft fire control system is verified by the extinguishing of the target indicator light. For further details of the fire control system, refer to paragraph 7-196. This red indicator light ceases to burn when the radar is locked on a target or when the power switch, located on the control panel, is in the "STDBY MAN" position. The range meter and the target indicator light are located, as one assembly, on top of the instrument panel shroud. The range meter sweeps in the absence of targets and stands steady at the proper range when the radar is locked on a target.

## Note

The range meter provides only an approximate indication of range. Accuracy within  $\pm 10$  percent on the range meter is acceptable. If excessive error in indicated range is suspected, the range meter *should* be removed and calibrated in an instrument shop.

The crystal current meter, located on the center pedestal, is used to indicate proper operating condition of the radar ranging equipment. When the equipment is operating properly, the crystal current meter will stand steady between 0.3 and 0.8 on the scale when the power switch is in the "ON" position. The use of test set, AN/APM-72, permits independent alignment of the radar range circuits or aircraft fire control system and the calibration of the radar range voltage without the use of a corner reflector simulated target. D-C electrical power requirements for the radar set are 3.2 amperes at 27.7 volts. D-C power for the radar ranging equipment is controlled by a 5-ampere, push-pull type circuit breaker located on the right-hand console circuit-breaker panel. A-C requirements are 103.0 watts and 43.7 vars "C" phase to ground and 265.0 watts and 51.5 vars "A" phase to ground, protected by two 5-ampere fuses. Fuses are located on the radar bay fuse panel. (See figure 9-20 for schematic.)

## 9-72. TROUBLE SHOOTING RADAR SET, AN/APG-30A.

9-73. Although repairs which may be made with the equipment installed in the airplane are limited, it is possible to correct some of the trouble which may occur. In the event of faulty operation, or equipment failure during flight or ground operational check, the following steps may be performed:

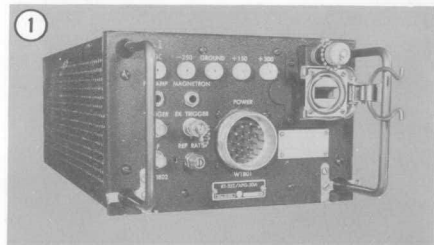
a. Check the primary power sources for proper supply voltages. With the equipment drawing full load, the a-c and d-c supplies deliver 112 to 118 volts and 27.7 volts, respectively.

b. In case of equipment failure, the fuses on the power supply-range computer and the voltage regulator should be checked and replaced as necessary. If a replacement fuse fails, a short circuit exists in the particular units protected by that fuse and such units should be replaced or wiring repaired as required. Never use a larger fuse than the specified value.

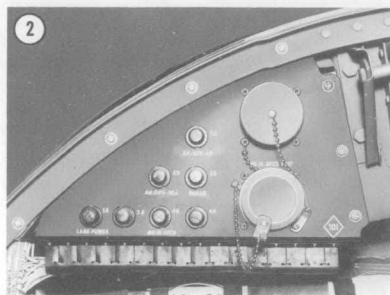
c. Cables should be checked for abrasion, ruptured insulation, corroded or loose connections, shorts and open circuits.

d. Inspect ground connections for loose or corroded connections and tighten or clean as necessary.

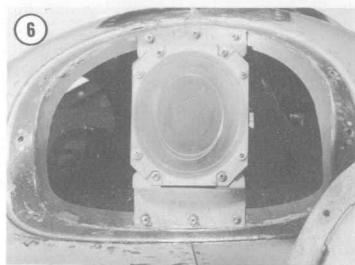
e. By substitution, including cables, trouble may be isolated and the defective unit replaced.



FREQUENCY CONVERTER-TRANSMITTER (RT-322/APG-30A)



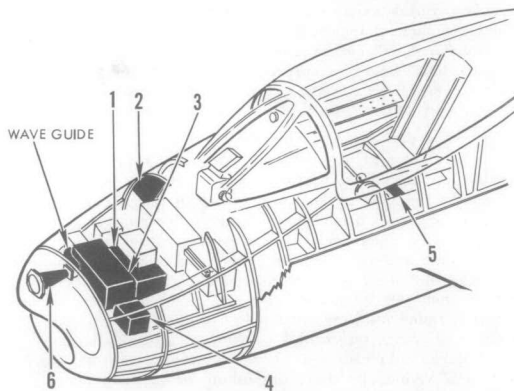
RADAR TEST RECEPTACLE AND FUSE PANEL



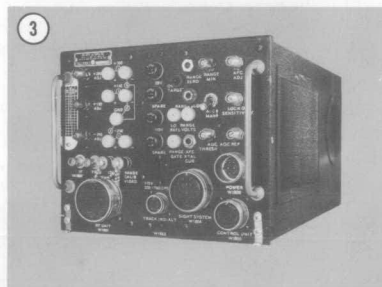
ANTENNA (AT-561/APG-30)



CONTROL PANEL (C-775/APG-30)



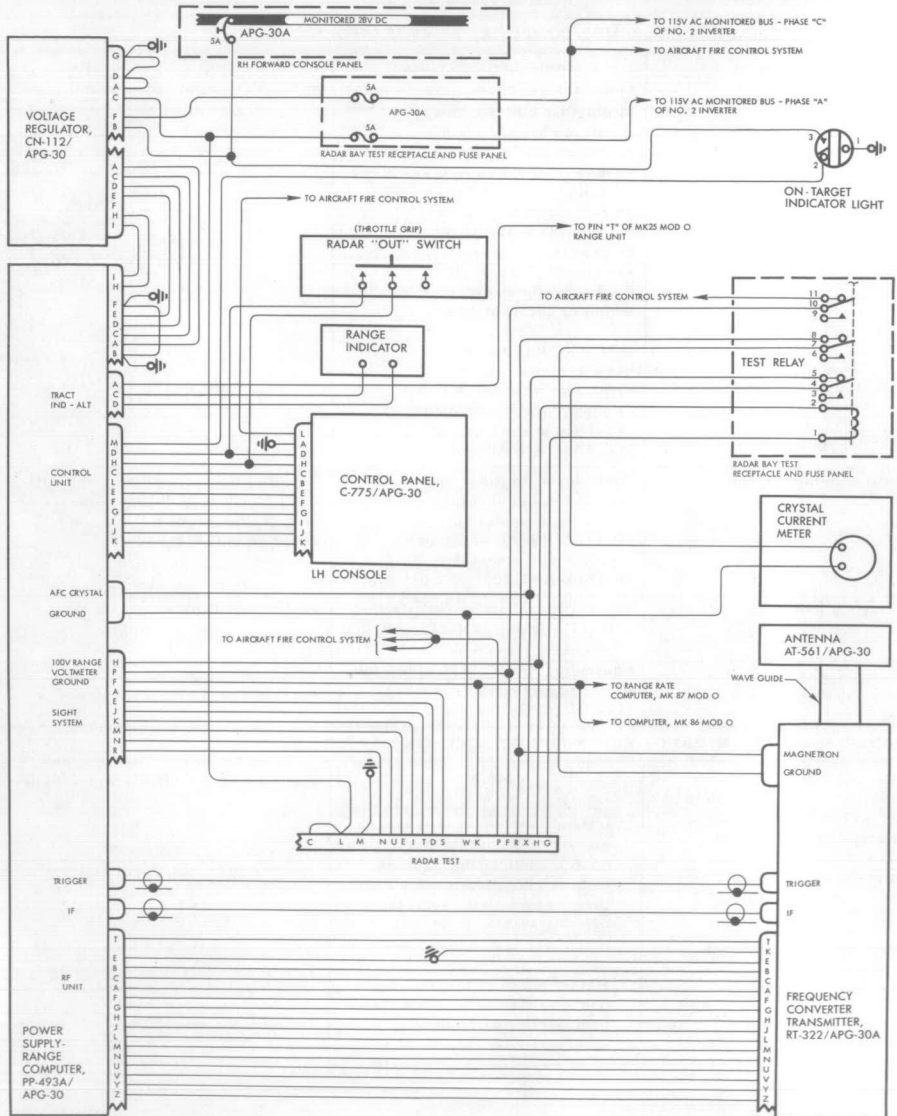
VOLTAGE REGULATOR (CN-112/APG-30)



POWER SUPPLY RANGE COMPUTER (PP-493A/APG-30)

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Figure No. 9-19. Radar Set, AN/APG-30A, Equipment Location



FJ-48-274-2

Figure No. 9-20. Radar Set, AN/APG-30A, Schematic

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>NO RANGE VOLTAGE FROM RANGE COMPUTER, PP-493A/APG-30.</b>		
No d-c voltage to set.	<p>Make certain APG-30A circuit breaker is engaged.</p> <p>Disable a-c and d-c power to set, remove electrical connector, J-701, from voltage regulator, CN-112/APG-30, and check for 28 volts dc on pins "B" and "E" with APG-30A circuit breaker re-engaged. If 28 volts is not present, discrepancy is in airplane's wiring or circuit breaker.</p> <p>If 28 volts dc is present, but d-c interruption is still suspected, trace set wiring as shown in the Handbook of Service Instructions for Radar Set, AN/APG-30A.</p>	Repair airplane's wiring or d-c distribution system as required.
No a-c voltage to set.	Check fuses on radar bay fuse and test panel and in the voltage regulator, CN-112/APG-30, and power supply-range computer, PP-493A/APG-30.	Replace fuses as required with exact replacement only. If replacement fuse fails, replace radar set units until defective unit is found.
Defective unit (fuses OK).	Replace the following for effect: voltage regulator, CN-112/APG-30, frequency converter-transmitter, RT-322/APG-30A, and power supply-range computer, PP-493A/APG-30.	Replace applicable unit.

**RADAR SEARCHES IN RANGE BUT WILL NOT LOCK ON TARGET.**

One of the following units defective: voltage regulator, CN-112/APG-30, power supply-range computer, PP-493A/APG-30, and frequency converter-transmitter, RT-322/APG-30A.	<p><b>Note</b></p> <p>The interdependence of all radar system units upon each other prevents an accurate diagnosis of trouble while in the airplane without elaborate test equipment. Unless power to the set is found to be deficient or lacking, repair will be expedited by replacing system units. Further repair of the defective unit may then be accomplished as a bench operation.</p>	Replace units until faulty one is found.
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9-74. CALIBRATING RADAR SET, AN/APG-30A.  
9-75. Should it be necessary to calibrate the system, when installed, connect test set, AN/APM-72, to the test receptacles provided in the aft upper portion of the nose equipment compartment and on the radar units; then, proceed according to instructions accompanying the test set.

#### 9-76. RADAR SET CONTROLS.

9-77. Most operational controls for the radar set, AN/APG-30A, are located on the control panel, C-775/APG-30. A 5-ampere, push-pull type circuit breaker is located on the right-hand console circuit-breaker panel to protect the 28-volt d-c power to the equipment. The controls on the control panel are a power switch (ON—STDBY MAN—OFF), a maximum range control (MAX RANGE) and a range gates switch (GATES OUT).

#### Note

When the equipment is placed directly "ON" without a warm-up period in "STDBY MAN," a 3-minute delay period is required to secure complete operation.

The power switch functions are as indicated on the panel. The MAX RANGE control permits manual control of the maximum range at which the system will lock on a target. The range gates out switch performs the same function as the radar in or out switch (RANGE) on the power control lever. These two switches cause the radar system to unlock when they are placed in the "OUT" position. Controls and switches are as follows:

NAME OF CONTROL	FUNCTION
CONTROL PANEL, C-775/APG-30	
ON — STDBY MAN — OFF	Permits primary power control. The system is fully operative in the "ON" position and the plate power is removed when in the "STDBY MAN" position.
MAX RANGE	Controls maximum range of the system (approximately 2000 to 3000 yards).
GATES OUT	Causes the system to be unlocked in the "OUT" position and to lock on the next farthest target when returned to the "ON" position.
POWER CONTROL LEVER	
RANGE	Performs the same function as the GATES OUT switch.

#### 9-78. OPERATIONAL CHECK OF RADAR SET, AN/APG-30A.

9-79. To perform an operational check of radar set, AN/APG-30A, proceed as follows:

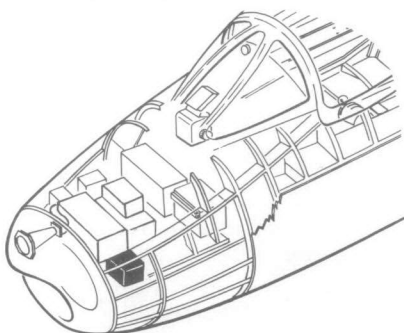
- Check all interconnecting cables for frayed insulation or broken wires.
- Check all components for damage.
- Check retaining screws of all vibration mounts and units.
- Check for continuity between components.
- Check both operating and spare fuses.
- Connect an external power source to the airplane.

### WARNING

Operation of the radar equipment involves the use of high voltages which are dangerous to life. Operating personnel must observe all safety regulations at all times.

- Place system in operation.
- Connect test set, AN/APM-72, to test receptacle and place in operation.
  - Check d-c voltage input to the system; voltage should be between 24 and 29 volts to assure proper and safe operation of the system.
  - Check a-c voltage input to the system; voltage should be between 110 and 120 volts at 400 cycles to assure proper and safe operation of the system.
  - Place MARKER SELECTOR control of test set, AN/APM-72, to 900 to 2250 position and check lock-on function of the system.
    - Range meter should read 300 to 750 yards.
    - Depress GATES OUT switch or RANGE switch on power control lever when a target echo is being supplied by the range calibrator. The target indicator light should again extinguish or the radar is not locked on.
    - Turn radar and range calibrator "OFF."
    - Remove test set.
    - Remove external power source.

9-80. REMOVING AND INSTALLING VOLTAGE  
REGULATOR, CN-112/APG-30.



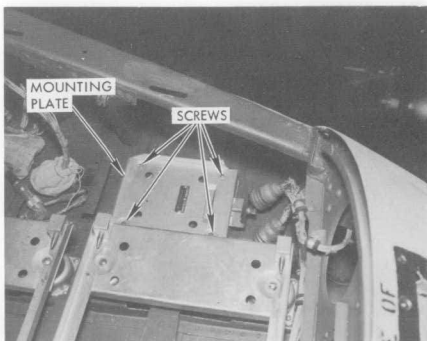
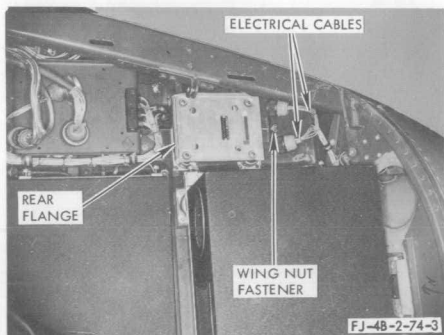
REMOVING

**Caution** Make certain power is not applied to system.

**Note** If LABS equipment is to be installed, proceed as follows:

- 1** Remove radar compartment access door.
- 2** Disconnect two electrical cables from face of unit ("W1806" and "W1807").
- 3** Loosen wing nut fastener on front of unit.
- 4** Tip unit slightly forward to disengage rear flange; then lift aft out of airplane.

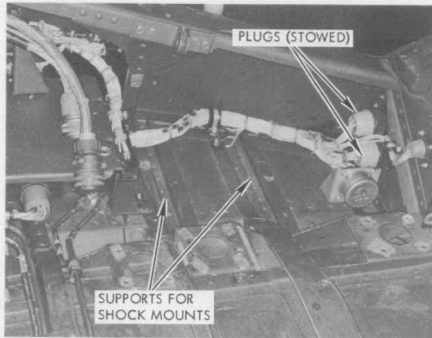
- 5** Remove mounting plate (MT-708/APG-30) secured by four screws.



- 6** Remove four shock mounts from supports.

FJ-4B-2-74-4

- 7** Stow the two cables on forward dummy receptacles.



## INSTALLING

**Caution** Make certain power is not applied to system.

- 1** On some airplanes, LABS equipment may be installed in the radar compartment. If LABS equipment is installed, proceed as follows to prepare the airplane for the installation of the voltage regulator, CN-112/APG-30:

A. Remove LABS equipment and associated mounting plate. Refer to Supplemental Handbook of Maintenance Instructions, (NAVAER 01-60JKE-502A).

B. Fasten four shock mounts to holes in support.

C. Secure mounting plate (MT-708/APG-30) to shock mounts with four screws.

- 2** Position unit on mount, making certain that rear flange is engaged.

**3** Lift wing nut fastener up over front flange and tighten. Safety fastener using AN995F32 safety wire.

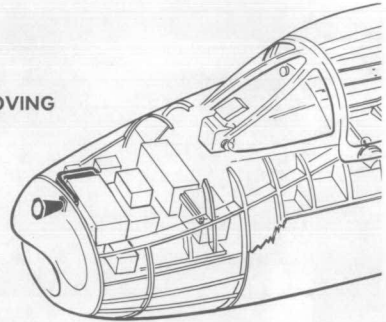
**4** Connect and safety-wire two cables to face of unit "W1806" and "W1807." (These cables will be found in a stowed condition.)

- 5** Replace radar compartment access door.

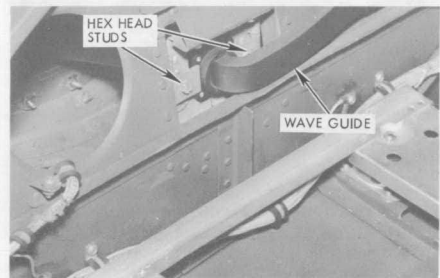
FJ-4B-2-74-5

## 9-81. REMOVING AND INSTALLING RADAR ANTENNA, AT-561/APG-30, AND WAVE GUIDE.

### REMOVING

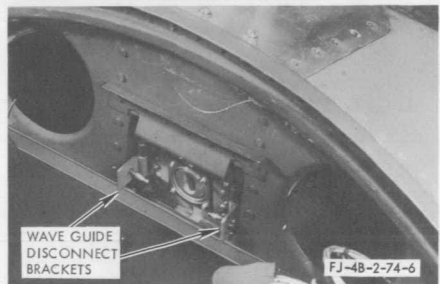


- 1** Disable a-c and d-c supply to radar set, AN/APG-30A.
- 2** Remove radar bay cover and gain access to APG-30A antenna disconnect.



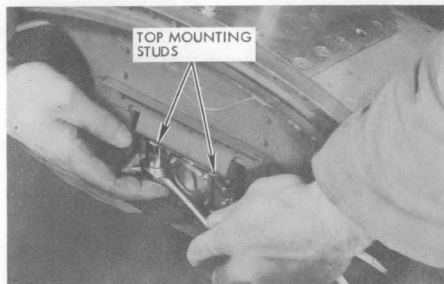
- 3** Unfasten wave guide from antenna by loosening two hex head studs on wave guide disconnect brackets and swinging brackets back and away from wave guide.

- 4** Remove wave guide from antenna disconnect and retain rubber gasket.

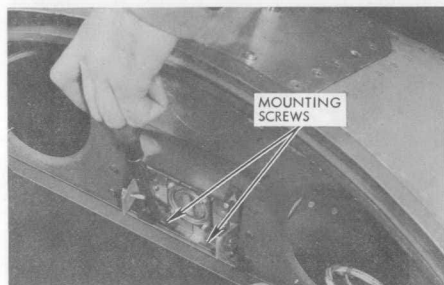




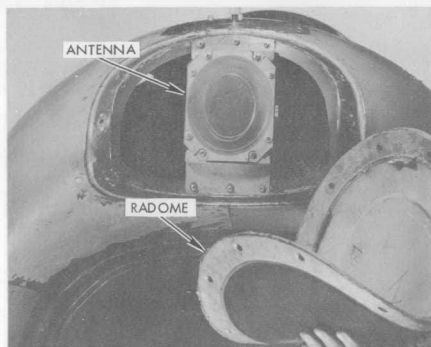
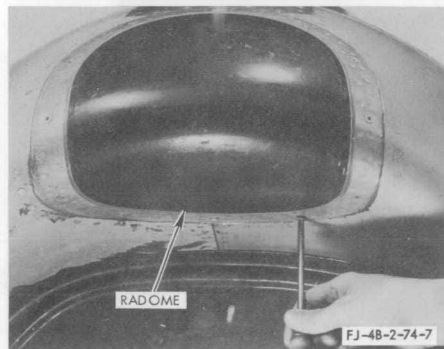
- 5** Remove two mounting studs from top of antenna disconnect.



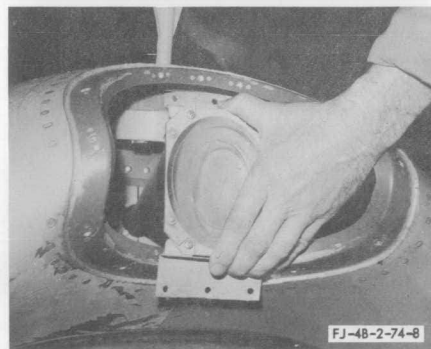
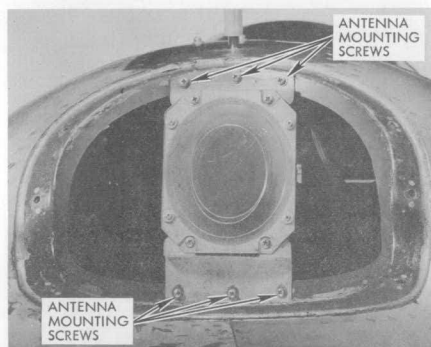
- 6** Loosen two mounting screws at bottom of antenna disconnect.



- 7** Remove twelve radome mounting screws and pry radome gently to break seal. Remove radome.



- 8** Remove three top and three bottom screws from antenna mounting bracket and slide antenna gently forward to disengage from its aft mounting. Remove from airplane.

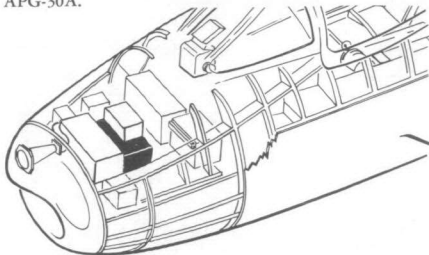


## INSTALLING

- 1** Carefully slide antenna into position with slotted flange in bottom of aft mounting bracket engaging under mounting screws and washers. Do not tighten aft mounting screws.
- 2** Install six mounting screws on forward antenna mounting brackets.
- 3** Install radome with twelve mounting screws, making certain that enough sealant is present to properly seal edges of radome.
- 4** Install two upper mounting bolts on aft mounting bracket.
- 5** Tighten two lower mounting screws on aft mounting bracket.
- 6** Install rubber wave guide gasket and wave guide and clamp wave guide onto antenna disconnect by tightening two hex head screws.
- 7** Perform operational check of radar set, AN/APG-30A.

FJ-4B-2-74-9

## 9-82. REMOVING AND INSTALLING FREQUENCY CONVERTER-TRANSMITTER, RT-322/APG-30A.

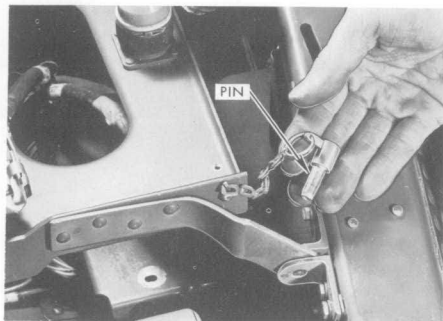


## REMOVING

**Caution** Make certain that power is not applied to system.

- 1** Remove radar compartment access door.
- 2** Disengage electrical connectors from the angle-of-attack and angle-of-sideslip compensator and the coder unit, KY-81/APA-89, both of which are mounted on the radar equipment shelf.
- 3** Pull two pins from the left-hand side of the radar equipment shelf.

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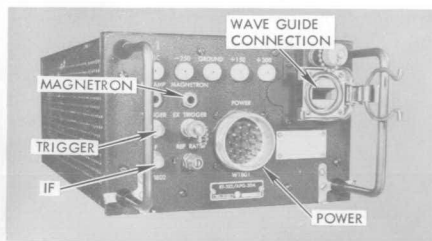


- 4** Carefully swing radar equipment shelf into the up-right position.



- 5** Disconnect four cables from the face of unit, ("POWER," "MAGNETRON," "TRIGGER" and "IF").

- 6** Disconnect wave guide from face of unit.



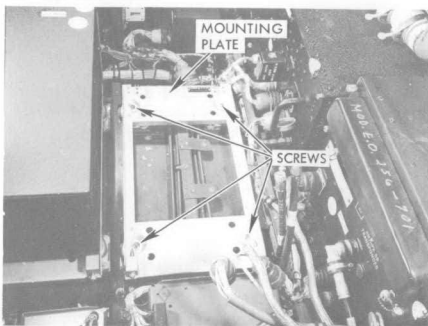
- 7** Loosen wing nut fasteners.

FJ-48-2-74-11A

- 8** Pull unit free of spring-loaded positioning pins on mount and lift from airplane.

*Note* If LABS equipment is to be installed, proceed with the following steps.

- 9** Remove mounting plate, MT-707/APG-30, secured with four screws.

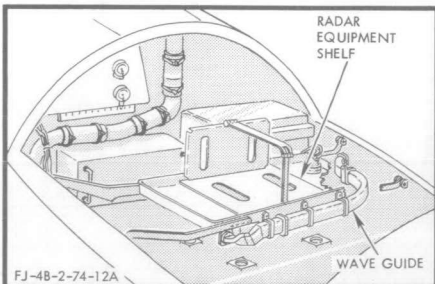


- 10** Remove four shock mounts.

- 11** Stow "POWER" cable to the right side on the dummy receptacle.



- 12** Disconnect forward end of wave guide from the antenna and clamp wave guide to forward face of radar equipment shelf.



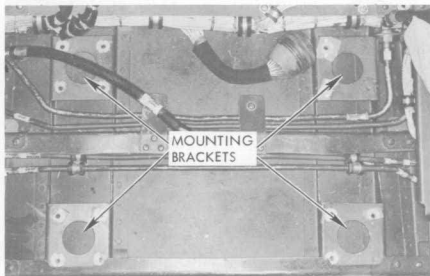
FJ-48-2-74-12A

## INSTALLING

**Caution** Make certain power is not applied to system.

**1** LABS equipment may be installed in the radar compartment. If LABS equipment is installed, proceed as follows to prepare the airplane for the installation of the frequency converter-transmitter, RT-322/APG-30A.

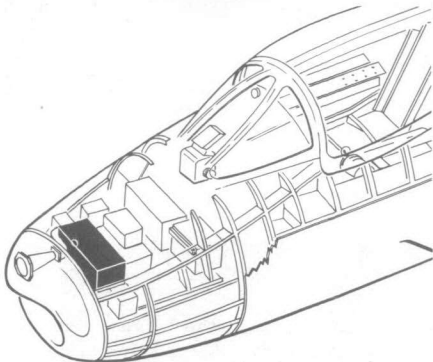
- A. Remove LABS equipment and associated mounting plate. Refer to Supplemental Handbook of Maintenance Instructions (NAVAER 01-60JKE-502A).
- B. Install four shock mounts on mounting brackets.



- C. Secure mounting plate, MT-707/APG-30, to shock mounts with four screws.
- 2** Position unit on mount and slide into mount making certain that positioning pins in mount align with holes in unit.
- 3** Tighten and safety-wire wing nut fasteners. Use AN995F32 safety wire.
- 4** Connect wave guide to face of unit.
- 5** Connect electrical cables to face of unit ("POWER," "MAGNETRON," "TRIGGER" and "IF").
- 6** Reposition radar equipment shelf and install two pins.
- 7** Engage and safety-wire electrical connectors on the angle-of-attack and angle-of-sideslip compensator and coder unit, KY-81/APA-89.
- 8** Replace radar compartment access door.

FJ-48-2-74-13A

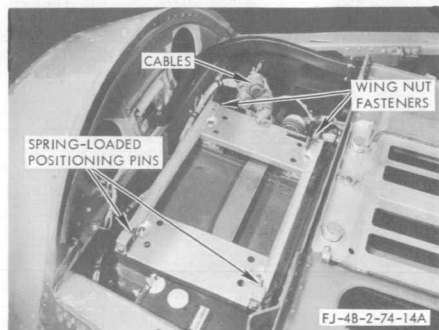
## 9-83. REMOVING AND INSTALLING POWER SUPPLY-RANGE COMPUTER, PP-493A/APG-30.



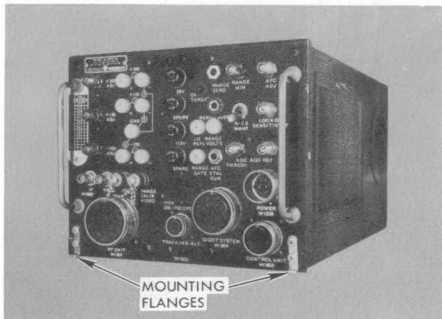
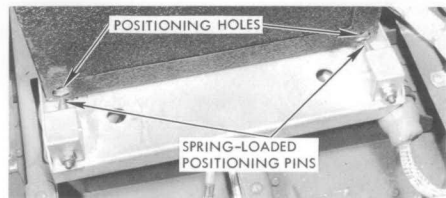
## REMOVING

**Caution** Make certain power is not applied to system.

- 1** Remove radar compartment access door.
- 2** Disengage electrical connectors from the face of unit.
- 3** Loosen two wing nut fasteners at bottom face of unit.
- 4** Pull unit free of spring-loaded positioning pins and lift from airplane.

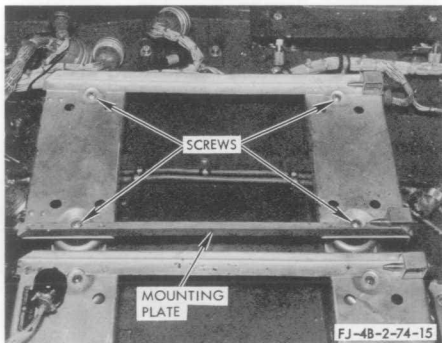


FJ-48-2-74-14A

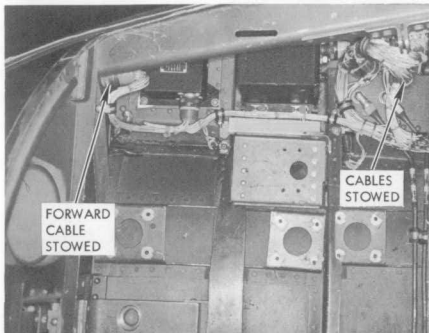


**Note** If LABS equipment is to be installed, proceed with the following steps.

- 5** Remove mounting plate, MT-739/U, secured by four screws.



- 6** Remove four shock mounts.
- 7** Stow five plug end cables on the dummy receptacles to the right side of the compartment (one forward).



## INSTALLING

**Caution** Make certain power is not applied to system.

- 1** If LABS equipment is installed, proceed as follows to prepare the airplane for the installation of the power supply range computer, PP-493A/APG-30A.
- A. Remove LABS equipment and associated mounting plate. [Refer to Supplemental Handbook of Maintenance Instructions, (NAVAER 01-60JKE-502A).]
  - B. Fasten four shock mounts to mounting brackets.
  - C. Secure mounting plate, MT-739/U, to shock mounts with four screws.
- 2** Place unit on mount and slide inboard making certain that spring-loaded positioning pins align with positioning holes in unit.
- 3** Connect electrical cables to face of unit.
- 4** Pull two wing nut fasteners up over mounting flanges on face of unit. Tighten and safety wing nuts.
- 5** Replace radar compartment access door.

FJ-4B-2-74-16A

9-84. BASIC MAINTENANCE OF  
RADAR EQUIPMENT.

9-85. Maintenance of radar equipment is largely beyond the scope of this handbook. However, certain items of preventive maintenance can be employed without disturbing components and wiring. Routine preventive maintenance should include the following:

- a. Check wire installations and electrical connectors regularly for proper securing of cables and connectors.
- b. Be careful not to use the tops of components for steps when in the radar bay area.
- c. Handle radar wave guides with extreme care to prevent kinking of metal liner. A distorted wave guide

can affect system operation drastically without its being readily apparent.

d. Avoid storing airplane in a radar testing area. The unattended airplane may be in the path of a radar beam which can enter its radar antenna and cause damage to the receiver-transmitter, especially the r-f mixer section.

e. Keep airplane nose pointing away from other airplanes and personnel while operational check is being made.

f. Assure good ground straps on all mounts.





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